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ABSTRACT

This report describes the effects of 48 hours of sustained operations on the performance of tank crews in communication, driving, surveillance, gunnery, and maintenance tasks. It is a continuation of research to determine the endurance of troops using combat equipment with 48-hour capability. Proficiency tests were constructed for each type of tank-crew activity and made part of a 12-hour field exercise. Two groups of crews were used; one group negotiated a problem course four consecutive times for a total of 48 hours of continuous operation, and a control group followed the same procedure but had 24-hour rest periods between each 12 hours of operation. Only moving surveillance and some driving activities showed significant performance deterioration over a 48-hour period of work without sleep. Major conclusions were: (1) No serious performance decrements result from operating present tank equipment continuously for 48 hours without sleep; (2) Performance at night is not significantly affected by the subject's diurnal rhythm; (3) No major changes in present unit organization and tactical doctrine are necessary to accomplish continuous tank operations for periods up to 48 hours. (Author/CK)

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Report
71-16

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The Effects of a 48-Hour Period of Sustained Field Activity on Tank Crew Performance

L.L. Ainsworth and H.P. Bishop

HUMAN RESOURCES RESEARCH ORGANIZATION
300 North Washington Street • Alexandria, Virginia 22314

July 1971

Prepared for

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Department of the Army
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DEPARTMENT OF THE ARMY
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August 13, 1971

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SUBJECT: The Effects of a 48-Hour Period of Sustained Field Activity on Tank Crew Performance

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1. This report describes the effects of 48 hours of sustained operations on the performance of tank crews in communication, driving, surveillance, gunnery, and maintenance tasks. It is a continuation of research to determine the endurance of troops using combat equipment with 48-hour capability.

2. Proficiency tests were constructed for each type of tank-crew activity and made part of a 12-hour field exercise. Two groups of crews were used; one group negotiated a problem course four consecutive times for a total of 48 hours of continuous operation, and a control group followed the same procedure but had 24-hour rest periods between each 12 hours of operation. Only moving surveillance and some driving activities showed significant performance deterioration over a 48-hour period of work without sleep. Major conclusions were that (a) no serious performance decrements result from operating present tank equipment continuously for 48 hours without sleep; (b) performance at night is not significantly affected by the subject's diurnal rhythm, and (c) no major changes in present unit organization and tactical doctrine are necessary to accomplish continuous tank operations for periods up to 48 hours.

3. This report should be of interest to personnel concerned with combat operations, and with research and training, especially under conditions of continuous performance for long periods without sleep.

FOR THE CHIEF OF RESEARCH AND DEVELOPMENT:

Frank H Duggins

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16. Abstracts

A 48-hour field experiment was conducted to determine the effects of sustained activity on the performance of tank crews in communication, driving, surveillance, gunnery, and maintenance activities. Only moving surveillance and some driving activities showed statistically significant performance deterioration over a 48-hour period of work without sleep, but these decrements were not considered to be of practical significance. The experiment showed that the diurnal rhythm of the subjects did not affect performance significantly. The research indicates that changes in unit organization or tactical doctrine are not necessary to accomplish continuous operations. The results of the experiment support the broad conclusion that tank crews using present equipment can maintain operational proficiency during 48 hours of sustained activity.

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The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

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FOREWORD

The overall objectives of Work Unit ENDURE are to determine the endurance of troops using combat equipment with a 48-hour capability, and, as necessary, to establish ways of extending the endurance of troops so that the effectiveness of the equipment will not be limited by the user. The research under this Work Unit is being conducted by the Human Resources Research Organization at the request of the U.S. Army Combat Developments Command Armor Agency and U.S. Army Combat Developments Command Institute of Advanced Studies.

Before the research described in this report was planned, a Consulting Report, *Summary of Literature Review on Extended Operations*, December 1964, was published summarizing the psychological literature pertaining to performance over extended periods of time. On the basis of that review, a laboratory experiment, ENDURE I, was conducted to determine the effects of extended operations on selected tank crew activities. The results, reported in HumRRO Technical Report 69-8, *The Effects of Sleep Deprivation on Performance Over a 48-Hour Period*, indicated that significant performance decrements would occur over extended periods of continuous operation, particularly with relation to the subject's normal diurnal cycle.

This report describes the research conducted under ENDURE II, Field Studies of Performance of Combat Duties for Extended Periods. The purpose of this research was to extend the laboratory findings to include the communication, maintenance, driving, surveillance, and gunnery activities of the tank crew under actual field conditions. The report presents the results of the research and discusses the implications for extended combat.

The research was conducted at HumRRO Division No. 2, Fort Knox, Kentucky, under the supervision of Dr. Norman Willard, Jr., Director of Research. Dr. Donald F. Haggard is the present Director. Dr. Harold Bishop is the present Work Unit Leader; Dr. L.L. Ainsworth was Work Unit Leader when the research for ENDURE II was conducted. The immediate field research staff consisted of Mr. John Cook, Mr. Eugene Drucker, Mr. Ralph Graham, and Mr. William Warnick. Support was provided by the U.S. Army Armor Human Research Unit; LTC John A. Hutchins, Jr., was military chief at the time the field research was completed.

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Meredith P. Crawford
President
Human Resources Research Organization

PROBLEM

Military equipment capable of operating for 48 hours or longer is now being developed. When it becomes available, this equipment will provide the potential for military personnel to participate in combat for a longer period than has been possible before. Little is known, however, about the effects of sustained combat on the personnel who will operate the equipment.

At the request of the U.S. Army Combat Developments Command Armor Agency, HumRRO reviewed the psychological literature and military records pertaining to the effects of prolonged performance. The review yielded little information about man's ability to perform for 48 hours or longer, and the information that was available often contained contradictions.

In order to obtain more reliable information on sustained performance, a laboratory investigation was conducted to determine how performing for 48 hours without sleep would affect work efficiency on simulated surveillance and driving tasks. Under laboratory conditions, there were large performance decrements. The decrements occurred particularly at night, and were more severe during the second night. Since the greater amount of physical activity in the field, as well as a possible increase in the motivation of the subjects, could reduce the magnitude of such performance decrements, it was considered necessary to conduct a 48-hour simulated combat field exercise to determine the degree to which the decrements found in the laboratory would be verified.

APPROACH

To simulate the combat situation, a 12-hour tactical problem was designed utilizing a specially constructed 35.7 mile-long problem course for tanks. The problem included offensive, defensive, and retrograde movements. Performance tests were conducted at specified points along the course for basic tank crew activities of communication, driving, surveillance, gunnery, and maintenance.

An experimental group of 20 tank crews was required to complete the 12-hour course four consecutive times for a total of 48 hours of activity without sleep. A control group of 10 tank crews also repeated the course four times but were given a 24-hour rest period between each 12-hour work period. Both time and performance accuracy scores were obtained in most of the performance tests. The effects of the continuous activity were determined by comparing the trends of the scores for the two groups during the course of the experiment, as well as comparing the magnitudes of their performance scores.

RESULTS

In comparison with the control group, the experimental group exhibited little performance decrement in the communication, gunnery, and maintenance exercises and in two of the driving exercises. The performance of the experimental group was significantly worse than that of the control group only in moving surveillance and in two of the driving exercises. Differences between the groups in the performance of these as well as the other exercises were small, however. Only minor and usually insignificant differences were found between the scores obtained during the day and those obtained during the night periods.

CONCLUSIONS

(1) Activities that demand a protracted high level of alertness or require complex perceptual-motor activity, such as the moving surveillance and some driving tasks, are the most sensitive to the adverse effects of loss of sleep.

(2) Under field conditions, tank crews are able to perform present-day communication, driving, surveillance, gunnery, and maintenance tasks without serious performance decrements during a 48-hour period without sleep.

(3) Under field conditions, performance at night is not significantly affected by the diurnal rhythms of the subjects (but may be affected by reduced visibility).

(4) The results of this investigation do not indicate that changes in unit organization or tactical doctrine are necessary to accomplish continuous tank operations for periods up to 48 hours.

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The Effects of a 48-Hour Period of Sustained Field Activity on Tank Crew Performance

MILITARY PROBLEM

The development of new military equipment that can be operated continuously for 48 hours provides the potential for around-the-clock fighting. The realization of this potential, however, depends upon the ability of personnel to maintain effective performance during prolonged operations. If equipment operators cannot sustain acceptable performance levels for 48 hours, techniques for enabling them to do so must be developed, or unit organization (e.g., stand-by crews) and tactical doctrine will require modification.

For this reason, the U.S. Army Combat Developments Command Armor Agency requested (July 1963) HumRRO to study the effects of continuous operations on armor personnel. The following objectives of the research were specified:

(1) To determine troop combat effectiveness as it is affected by fatigue resulting from continuous combat operations.

(2) To determine changes in unit organization and tactical doctrine that would reduce or eliminate causes of fatigue.

An Exploratory Study (ES-24), begun in July 1964 to identify areas in which research would be most useful, took the form of a review of the literature on extended operations (1). Although more than 1000 reports were screened, the literature reviewed did not provide clear-cut answers to questions about the probable effectiveness of troops operating continuously for 48 hours or more. Anecdotal reports suggested that troops have operated successfully for extended periods, but experimental evidence on the effects of prolonged task performance was meager. The time periods investigated were usually less than 24 hours, and while it was commonly concluded that prolonged performance requirements resulted in a performance decrement, some apparently similar investigations yielded conflicting results.

The loss of sleep as a separate variable affecting performance has received a great deal of attention. In general, it has been found that loss of sleep results in a performance decrement proportional to the amount of the loss. During periods of extended loss of sleep, individuals may be able to perform brief tasks well, but they cannot sustain good performance over long periods of time. Depending on the tasks, some loss in proficiency as well as an increase in reaction time may be caused by short lapses in alertness or so-called microsleeps. Broadly, a major factor which reinforces the effects of loss of sleep is a monotonous, seldom-changing stimulus condition common in vigilance or detection tasks, for example. On the other hand, the use of interesting and varied tasks, or the inclusion of physical activity may serve to increase motivation and alertness and help to reduce the effects of loss of sleep on measured performance.

Because the experimental evidence was meager and there were conflicting conclusions as to the effects of prolonged activity on task performance, it was concluded that further research was necessary. The first stage of this research (ENDURE I) was a laboratory study of the effects of sleep deprivation on continuous performance (2). The results of that research indicated that large performance decrements occur during 48 hours without sleep; these decrements occur primarily at night, and they are especially likely during the second night of a 48-hour period.

Because of important differences between motivation in the laboratory and in "real-life" field situations, however, it was decided that generalizations based on this study and applied to a combat-type situation would be tenuous. A field exercise was needed which would combine, if possible, the realism of a field exercise with the attention to data collection details that is possible in the laboratory.

RESEARCH PROBLEM

The major objective of this research was to determine whether the performance of tank crews in a tactical exercise will deteriorate during a continuous activity period of 48 hours. Other objectives were to determine the specific activities for which performance decrements may occur, the times at which they may occur, and the magnitude of such decrements.

METHOD AND PROCEDURE

OPERATIONAL CONTEXT

To meet the requirement that the data be of such nature as to permit generalization to combat conditions, the specific situations in which performance was tested were made as realistic as considerations of personnel safety and proper care of equipment would permit. The research was conducted at Fort Hood, Texas, in Training Area IV, a large, relatively isolated area, with varied terrain, and with access to firing ranges which were modified to meet the special requirements of the research.

A base camp and command post for control of the experiment were established in Area IV, with facilities for eating, sleeping, communication, maintenance, and medical care. A test course 35.7 miles long, consisting of 24.6 miles of secondary road and 11.1 miles of cross-country travel, was laid out to begin and end at the base camp. Test performance exercises were conducted at selected points along the course; approximately 12 hours were required for a single complete circuit of the course. A map of the training area, with the approximate locations of facilities, exercise sites, helipads, and routes used is shown in Appendix A.

All activities were carried out in the context of a tactical situation that included offensive, defensive, and retrograde movements, both day and night. To add realism and continuity, unscored exercises were included in the program. These consisted of opening the radio net and radio check, responses to fragmentary orders, and responses to aggressor activity.

"C" rations were the only food available to the subjects during test activity. No time was specified or special facilities provided for eating or toilet functions. Water for drinking was carried in canteens and in the water cans which are normally a part of the tank equipment.

All subjects were instructed that sleep was not permitted during test periods. Tank commanders, scorers, officers, and civilian research personnel attempted to see that these instructions were followed. In addition, the nature of the exercises and the terrain over which the operations were conducted strongly militated against sleep. It is assumed, therefore, that none of the crewmen slept enough to invalidate the data.

PROCEDURE

First, a pilot study, involving the use of five crews and lasting 12 hours, was conducted to determine any necessary changes in the plan, and to train scorers and other support personnel. Minor alterations in previously planned scoring procedures, distances, and schedule were made as a result of the study.

During the course of the main experiment, the sequence of events during a 12-hour test period was the same for the experimental and the control groups. The activity schedule for the two groups is shown in Figure 1. Only one platoon, experimental or control, was engaged in test activity during any given 12- or 48-hour period, and the two platoons of the control group were tested before the four platoons of the experimental group.

Schedule for Control and Experimental Groups

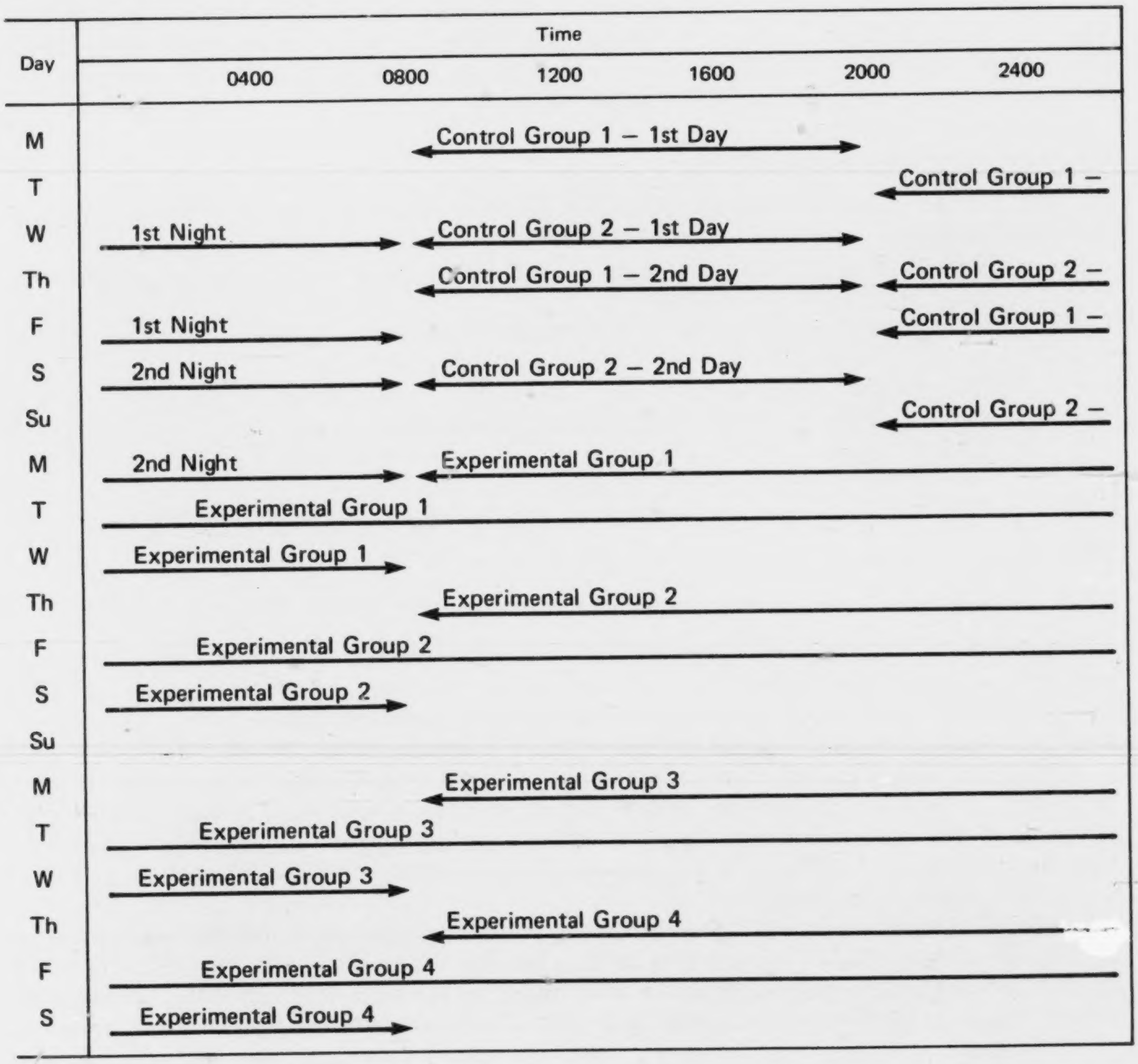
Day
Time
0400
0800
1200
1600
2000
2400
M
Control Group 1 – 1st Day
T
Control Group 1 –
W
1st Night
Control Group 2 – 1st Day
Th
Control Group 1 – 2nd Day
Control Group 2 –
F
1st Night
Control Group 1 –
S
2nd Night
Control Group 2 – 2nd Day
Su
Control Group 2 –
M
2nd Night
Experimental Group 1
T
Experimental Group 1
W
Experimental Group 1
Th
Experimental Group 2
F
Experimental Group 2
S
Experimental Group 2
Su
M
Experimental Group 3
T
Experimental Group 3
W
Experimental Group 3
Th
Experimental Group 4
F
Experimental Group 4
S
Experimental Group 4

Figure 1

The tanks of the platoon in action during the test period moved out onto the course, and at specified points along the route crews participated in the test exercises. These exercises were the same for the two groups and for each 12-hour period, with one minor exception, as noted in the following description of the exercises. A detailed list of the sequence of events, and copies of the Oral Operations Order and the Fragmentary Orders, are included in Appendix B.

DESCRIPTION OF TEST EXERCISES

The experiment included the unscored exercises, described earlier in the discussion of the operational context of the research, and the scored exercises described in the following paragraphs. All exercises were composed by HumRRO research personnel with the help of personnel from CDC Armor Agency and the U.S. Armor School, and with reference to relevant military publications. Each exercise was conducted once during each 12-hour period, except the Radiotelephone Procedures tests which were conducted three times each period. Most exercises were scored for both time and accuracy. Copies of the directions for the exercises are given in Appendix A.

Radiotelephone Procedures (RTP)

Six procedural tests were conducted at different times during each 24-hour period. The specific elements of RTP included in each exercise were as follows:

RTP 1: Word Twice; say Again Word Before/Word After; Acknowledgement; and Do Not Answer.

RTP 2: Phonetic Alphabet; Time and Coordinates; I Spell; Abbreviations Say Again All After/All Before; and Relay to/Form.

RTP 3: Say Again/I Say Again; Correction; Read Back/I Read Back; That Is Correct/Wrong; Verify/I Verify; and Wilco.

RTP 4, 5, and 6: These exercises were the same as RTP 1, 2, and 3, except that the specific message content was changed.

RTP exercises 1, 2, and 3 were used during the day and exercises 4, 5, and 6 during the night.

Driving Exercises

Log Obstacle. Tanks were required to cross a log obstacle three feet high. The crews were scored for proper performance of each of the following elements of proper crossing procedure: full stop; move forward slowly to contact; accelerate until on top of obstacle; decelerate on top of obstacle; hit ground without bouncing; move forward slowly.

Ditch. It was required that the tanks be driven through a ditch (2 feet deep, 15 feet long, and 10 feet wide) correctly and as fast as possible. Crews were scored for correctly performing the following elements of crossing procedure: shift to low; decelerate until tank hits bottom; accelerate after hitting bottom; decelerate on top of rear lip of ditch; hit ground without bouncing.

Slalom. Ten markers placed approximately 60 feet apart in a straight line made up the slalom course. Crews were required to drive the tanks along the line of markers as rapidly as possible, passing the markers alternately on the right and left sides. Crews were scored for each marker correctly passed and for the total time taken to pass the markers.

Minefield. A lane simulating the path through a minefield was laid out on level ground. The path was 18 feet wide, approximately 225 meters long, and included five 90° and four 45° turns. The markings were standard minefield signs and tape. The path was divided into 10 sections, each separated from the others by a turn. The crews were scored for errors, that is, the number of contacts with the masking tape, and for total time taken to pass through the minefield.

Surveillance Exercises

Passive Surveillance. In this exercise the tanks were stationed at the designated test site and the task of the crews was to detect and identify a number of targets. The targets—four tanks, four ¼-ton trucks, and four groups of dismounted troops—were exposed one at a time at ranges from 220 to 1010 meters, at various azimuths. During daylight the crews used binoculars and gunner's sighting devices as well as the unaided eye. At night the crews used infrared binoculars and gunner's sights as well as the unaided eye. The crews were scored for each target correctly detected and identified and for the time taken to detect and to identify the targets.

Moving Surveillance. As the tanks moved along the course they were fired upon by machine gun crews using blank ammunition. The tank crews were required to respond by returning the fire with the coaxial machine gun, using blanks during the day, and by illuminating the aggressor machine gun with the searchlight at night. The tanks were taken under fire from two positions, one to three miles apart, and the locations of the machine guns were changed among four positions so that they were never in the same places for two exercises in succession. The tank crews were scored for accuracy of detection of the source of fire.

Gunnery Exercises

The gunnery exercises were conducted in three phases. In Phase I the tank was stationary, and stationary targets were fired on with the main gun. In Phase II the tank was moving, and stationary targets were fired on with the coaxial machine gun. In Phase III the tank was stationary, and moving targets were fired on with the main gun and the caliber .50 machine gun. Illumination at night was provided by tank-mounted searchlights. Accuracy of fire was scored in all phases and time to first round was scored in Phases I and III.

Maintenance Exercises

The tank crews were scored for the correct performance of standard services and checks usually performed during operations. These checks included the engine oil level, transmission oil level, antennas, battery water and cables, vision devices, exterior lights, and fuel and lubricant leaks.

SUBJECTS

Subjects[1] for the study were 120 enlisted men assigned to a tables of organization and equipment (TOE) unit, 2nd Battalion, 67th Armor, at Fort Hood, Texas. Their ages ranged from 18 to 43 years with a mean of 22.0. Time in service ranged from 8 to 192 months with a mean of 30.8. The shortest time on the job was two days and the longest was nine years[2] with a mean of 5.1 months. General technical aptitude area (GT) scores of the subjects ranged from 53 to 138, with a mean of 103.5. One hundred nineteen subjects had from 6 to 12 years of formal education; one man had completed one year of college. Ranks of the subjects were as follows: PVT, 8; PFC, 27; SP4, 41; SP5, 12; SGT, 25; SST, 6; PSG, 1. Details of these data are given in Appendix C.

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[1] The men who participated in the pilot study did not serve as subjects for the main study, but were used in other roles (e.g., as scorers), and are not included in the data.

[2] Support requests specified subjects who had served at least six months in an armor TOE organization in the crew position they would fill as an experimental subject. Commitments of the support agency prevented complete compliance with the request.

The first 40 men assigned to the project were placed in the Control Group which consisted of 10 four-man crews (two platoons). The 80 men subsequently assigned to the project were divided into 20 four-man crews (four platoons) and assigned to the Experimental Group.[1]

EXPERIMENTAL DESIGN AND DATA ANALYSIS

The experimental paradigm was a 2 x 4 factorial design with two *conditions of rest* during the course of the experiment—0 and 24 hours—and four *cumulative levels of activity time*—12, 24, 36, and 48 hours. Conditions of rest constituted the Between-Subjects factor and levels of activity the Within-Subjects factor. Two other variables, subjects' physiological diurnal cycle and illumination (level and type), were confounded with the levels of activity, and therefore their effects could not be isolated.

The experiment was designed to produce data that would show the effects of extended periods of activity on performance in communication, driving, surveillance, gunnery, and maintenance activities. Repeated measures of performance in these five basic types of activities were obtained during successive 12-hour periods of activity for two groups of subjects.

The experimental group was scheduled for continuous activity during four consecutive 12-hour periods. The control group was also scheduled for four 12-hour activity periods, but was given a 24-hour rest between test periods.

The control group was used to provide criterion performance levels against which to compare the performance of the experimental group. Performance standards for troops in extended operations were not available and it was necessary to include a design control for the effects of practice since the same test exercises were used during the successive 12-hour periods.

To clarify the use of the control group, consider the following simplified description of possible results in the experiment: A significant effect of lack of rest would be shown by a decrement in performance after the first 12-hour period. If the effects of lack of rest were cumulative we would expect the results to show a trend of decreasing proficiency scores for successive 12-hour periods. The trend of the scores, however, would be modified by the effects of practice obtained during the repeated exercises, and the observed trend would depend upon the relative magnitudes of the effects of practice and lack of rest. Analogously, the effect of practice would be shown by a trend of increasing proficiency scores from period to period for the control group.

Since both groups were treated alike, with the exception of the rest periods scheduled for the control group, and both groups received the same amount of practice, a comparison can be made of the trends of the scores for the two groups and the inference made that any difference between the trends of the scores is due to the effects of the lack of rest. It may be noted that since the scores obtained for any specified period, as well as the absolute level of the scores, may be affected by non-experimental variables, a comparison of the trends of the scores for the two groups is the most important and informative comparison to be made.

The scores obtained during each test exercise were treated as data from separate experiments and analyzed independently. Mean performance scores were calculated with the combined data of all tanks in each group for each 12-hour period. No detailed analysis of the performance scores for single tanks or for individual members of the tank crews was attempted for two reasons: First, it was not feasible to monitor each individual every moment during the entire 48 hours of the experiment and it must be assumed that, as in combat, the crew members may have rotated crew positons so that the most proficient man would perform the duties required at a given time during the course of the experiment. Secondly, unavoidable non-experimental variables such as environmental conditions and the mechanical condition of tanks and equipment varied greatly during the course of the experiment for each tank and between tanks. The usefulness of detailed analysis, then, would be limited at best and possible serious errors would be made in an attempt to assess the effects of the experimental variables on performance.

---

[1] **Original plans specified control and experimental groups of equal size. Circumstances led to the decision to reduce the control group size, after the study had begun.**

The data from each of the time periods was also subjected to an analysis of variance. In this analysis, the test for interaction between the levels of rest and levels of total activity (Groups x Periods) was used to determine whether the trends of the scores of the two groups differed significantly. Tests were also made for significance of differences between the two groups in level of proficiency scores (Between Groups) and differences in scores between periods (Periods). In all tests the differences were tested for significance at the .05 level of confidence.

RESULTS

In the presentation of results, the relevant tables and graphs of time and accuracy scores are grouped according to the type of activity measured. Some tank crews failed to complete some of the exercises because of equipment failure or other problems, and the reduced number of subjects for these exercises is indicated with the table of scores. For simplicity of presentation, differences in scores, which are significant at the .05 level or better, are identified in the text with the presentation of the data, and the results of the analyses of variance are given in Appendix D.

RADIOTELEPHONE PROCEDURES (RTP)

The mean accuracy and message transmission time scores obtained in the separate RTP exercises are given in Table 1. The maximum mean accuracy scores for RTP

Table 1

Radiotelephone Procedures Mean Scores

Exercise	Group	12-hour Period							
		1		2		3		4	
		Accuracy[a]	Time[b]	Accuracy	Time	Accuracy	Time	Accuracy	Time
1 and 4	C	51.5	76	51.4	111	56.1	103	56.3	124
	E	51.6	85	49.4	99	49.4	87	52.1	89
2 and 5	C	122.5	179	112.5	236	122.2	214	120.0	229
	E	120.6	157	119.4	176	118.9	141	117.2	167
3 and 6	C	100.0	117	105.5	76	104.7	74	99.6	79
	E	102.9	61	105.1	52	105.5	57	104.1	59
Mean	C	91.3	124	89.8	141	94.3	130	91.9	144
	E	91.7	101	91.3	109	91.3	95	91.1	105

[a] The maximum mean accuracy scores for Radiotelephone Exercises 1-6 were: 75, 157, 135, 69, 146, and 141.

[b] In seconds.

Mean Radiotelephone Accuracy Scores: Successive 12-Hour Periods

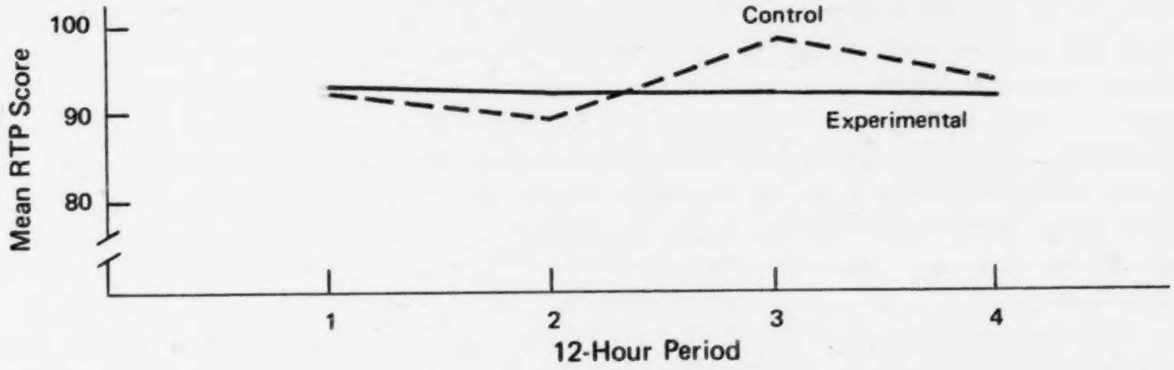

Figure 2

Mean Radiotelephone Time Scores: Successive 12-Hour Periods

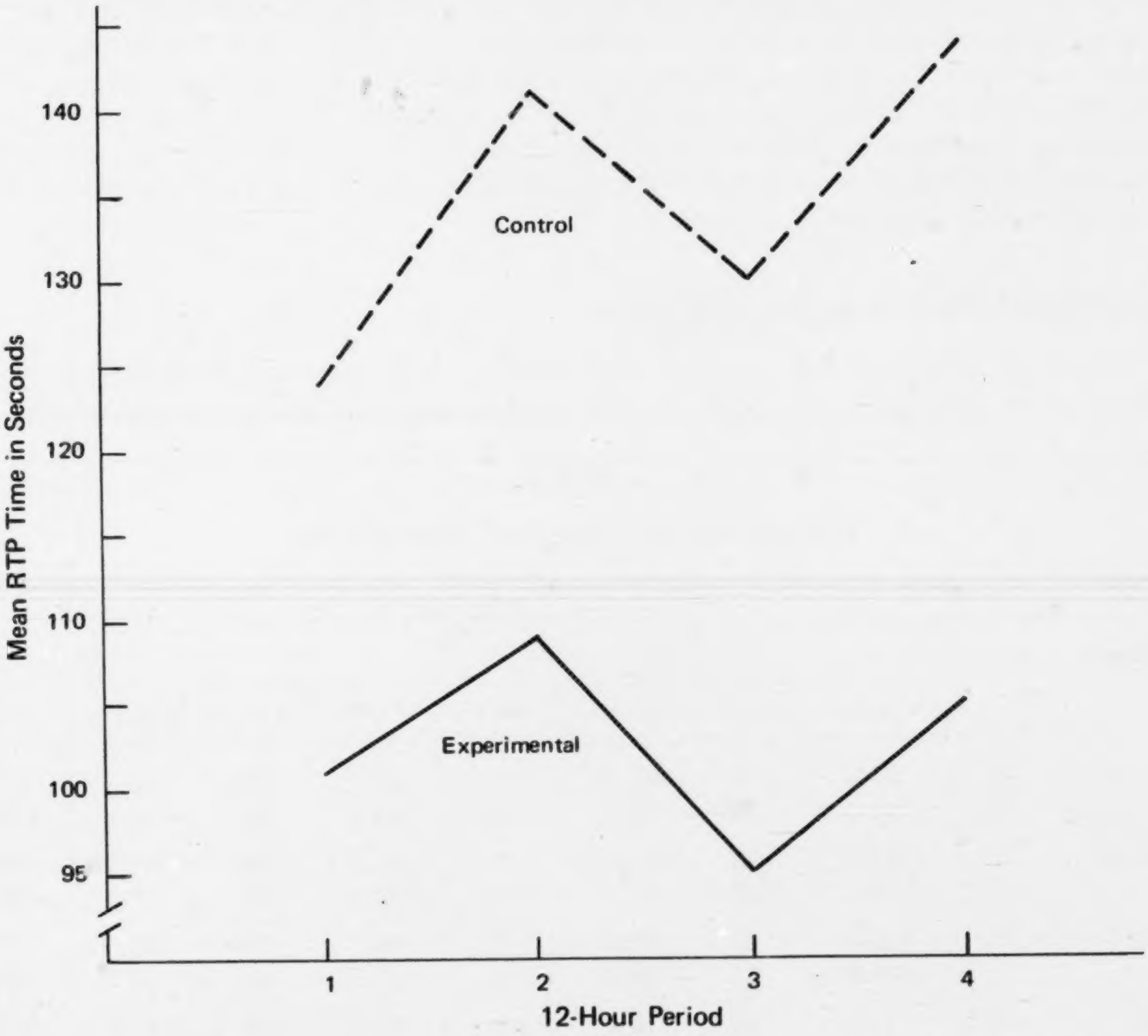

Figure 3

exercises 1 through 6 respectively, were 75, 157, 135, 69, 146, and 141. Since the specific procedural elements included in the messages were somewhat different for the three pairs of exercises, 1-4, 2-5, and 3-6, an analysis of data obtained for the separate pairs was carried out. The analysis indicated that there were no significant differences between groups in the trends of the scores, in performance accuracy, or any differences associated with the different periods of activity. The control group required significantly longer message transmission time, but this result, which is contrary to the expected direction of a difference if cumulative sleep loss was an effective variable, is probably due to equipment failures encountered during the RTP exercises for the control group particularly.

Since the analyses of the data indicated that the extended period of activity had no effect on the performance of the experimental group, the scores for the RTP exercises were combined and mean RTP scores calculated for each 12-hour period. These summary scores are plotted in Figures 2 and 3 which show the similarity in the trends of the scores for the two groups. The graphs also show the slightly greater time scores obtained during the night which suggests a minor effect of the subjects' diurnal cycle although the differences between day and night scores were not statistically significant.

DRIVING EXERCISES

The mean performance and time scores for the four driving exercises are summarized in Table 2. The performance and time scores for the individual exercises are plotted in Figures 4 to 11.

Log Obstacle. The mean performance accuracy and time scores are plotted in Figures 4 and 5. Figure 4 shows that the extended period of activity had no effect on the accuracy of the performance of the experimental group. Both groups received about four of the six possible points for accuracy in the first 12-hour period, and showed similar steady and significant improvement during the experiment. The main effect of the extended period of activity, seen in Figure 5, was to increase the crossing time for the experimental group in the exercises conducted after the first 12-hour period.

Table 2

Driving Exercises Mean Scores

Exercise	Group	12-hour Period							
		1		2		3		4	
		Accuracy	Time[a]	Accuracy	Time[a]	Accuracy	Time[a]	Accuracy	Time[a]
Log	C	4.2	29	4.8	30	5.1	26	5.6	26
	E	4.3^b	31^b	5.5	37	5.1^c	39^c	5.1	40
Ditch	C	3.9	30	4.3	44	4.6	36	4.6	41
	E	3.8	30	4.0	29	4.0^c	33^c	3.8	29
Slalom	C	10	59	10	55	9.8	54	9.9	55
	E	9.8^c	60^c	9.6	54	9.9^c	50^c	9.5	52
Minefield	C	4.0	135	3.0	146	2.1	137	2.3	102
	E	2.8^b	129^b	2.7^b	156^b	2.3^b	100^b	1.9^b	127^b

[a] In seconds.
[b] N=15
[c] N=19

Mean Log Obstacle Accuracy Scores: Successive 12-Hour Periods

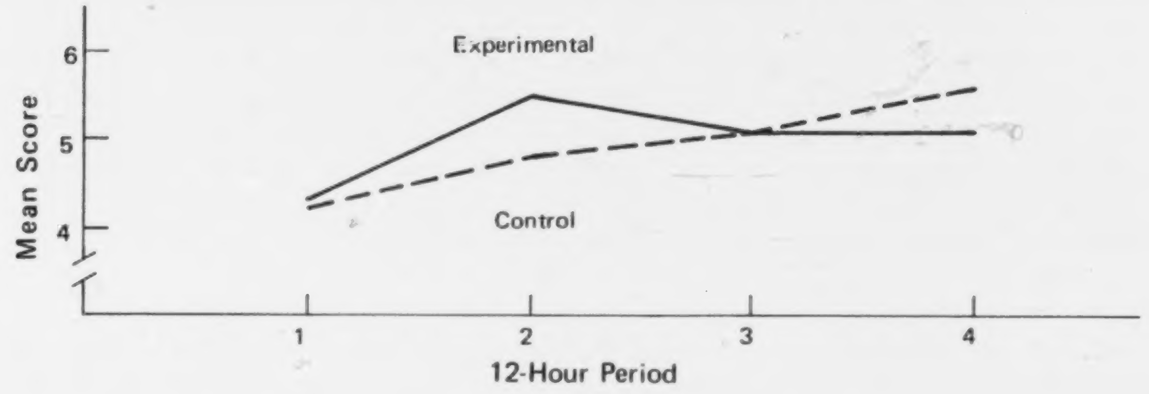

Figure 4

Mean Log Obstacle Crossing Times: Successive 12-Hour Periods

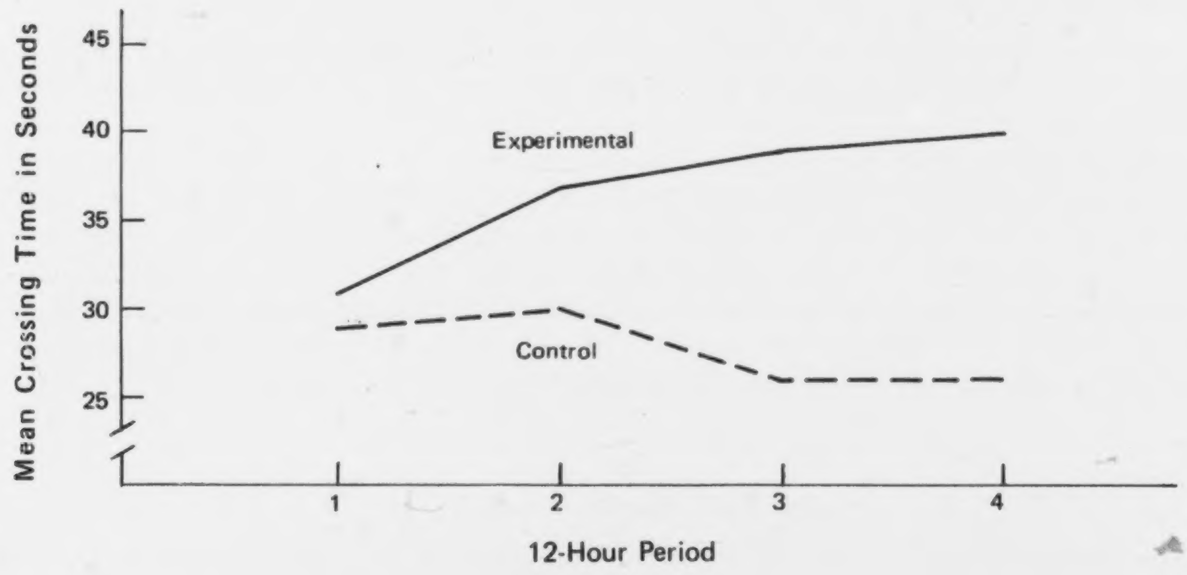

Figure 5

Ditch Crossing. The main accuracy and time scores obtained in the ditch crossing exercises, plotted in Figures 6 and 7, do not show any effect of the extended period of activity. The accuracy scores for both groups were relatively constant at about four of the maximum of five points during every 12-hour period and the only difference between groups is the significantly longer crossing time taken by the control group. The direction of this difference is contrary to the expected direction of any difference and probably reflects the effect of nonexperimental variables.

Slalom. The numbers of slalom markers the crews were able to successfully pass are plotted in Figure 8 which shows that the main effect of the extended period of activity was to depress the accuracy of the experimental group. The control group scores were nearly a perfect 10 throughout the experiment, but the experimental group scores were slightly, and significantly, smaller. This difference between groups was determined primarily by the increased number of errors committed by the experimental group during the two night periods; but the analysis of variance did not indicate any significant differences in scores for the different periods. The time scores, shown in Figure 9, were

Mean Ditch Crossing Accuracy Scores: Successive 12-Hour Periods

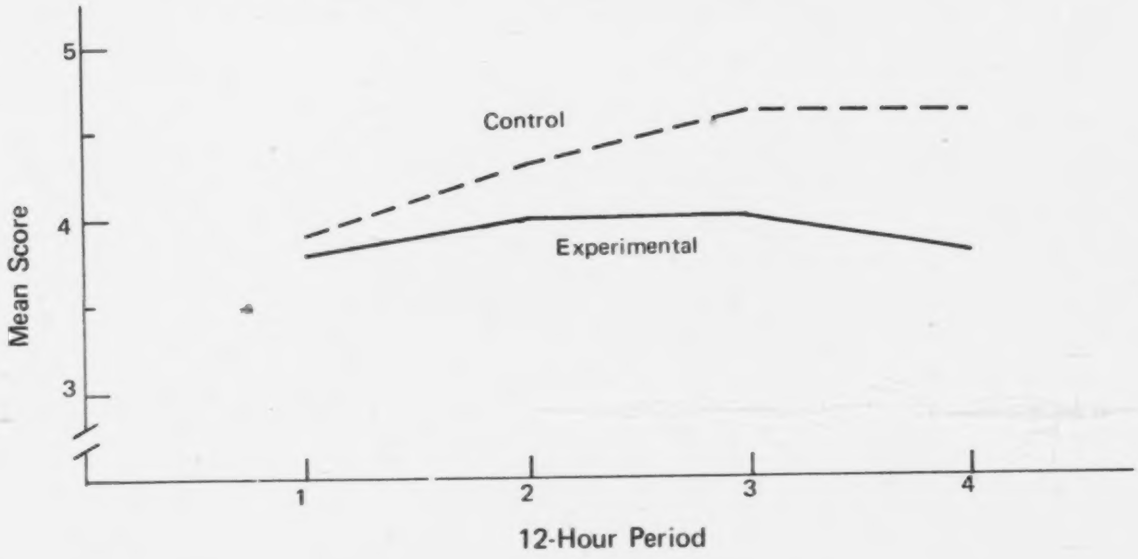

Figure 6

Mean Ditch Crossing Times: Successive 12-Hour Periods

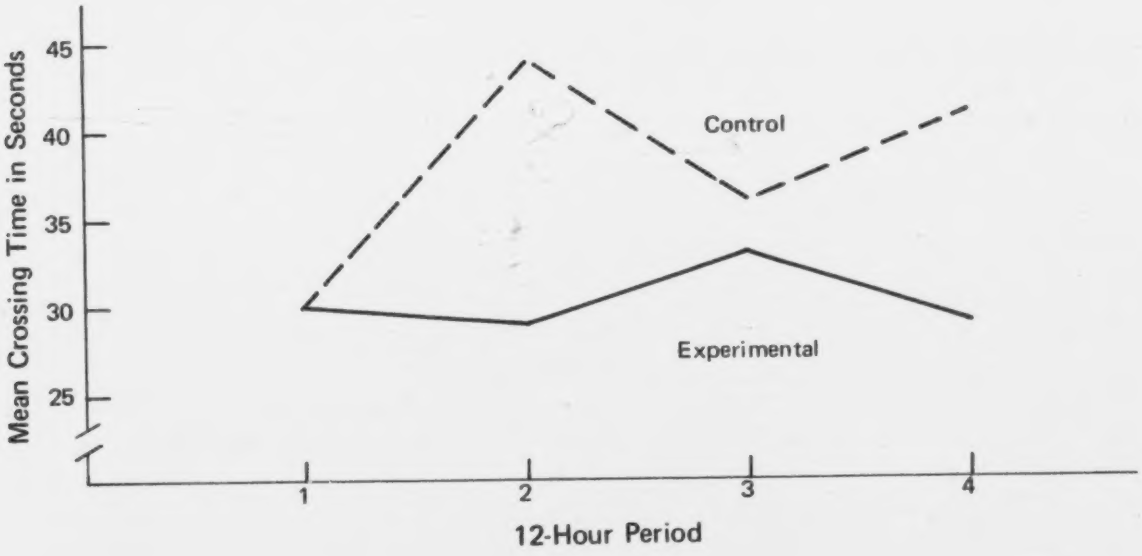

Figure 7

quite similar and both groups showed a significant decrease in the time required to drive the slalom course.

Minefield. The number of contacts with the path-marking tape and the time required to traverse the minefield are shown in Figures 10 and 11. These results show no effects of the extended period of activity. The performances of the two groups were quite similar. The number of contacts with the marking tape averaged between two and three, and both groups improved their time scores significantly during the course of the experiment.

Mean Slalom Accuracy Scores: Successive 12-Hour Periods

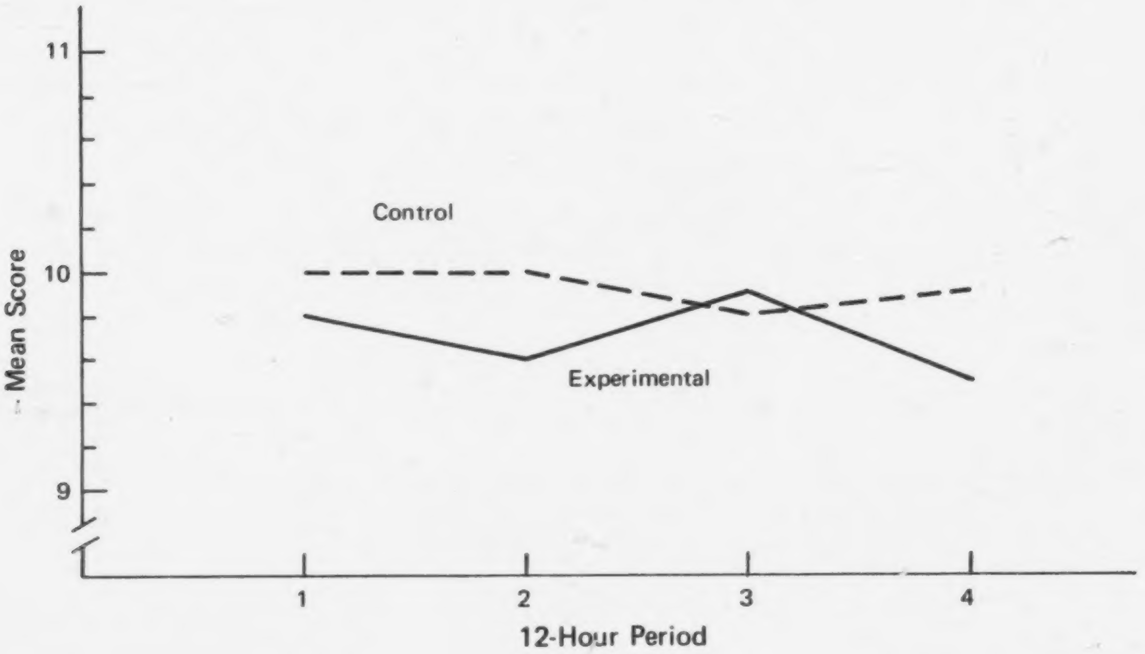

Figure 8

Mean Slalom Course Times: Successive 12-Hour Periods

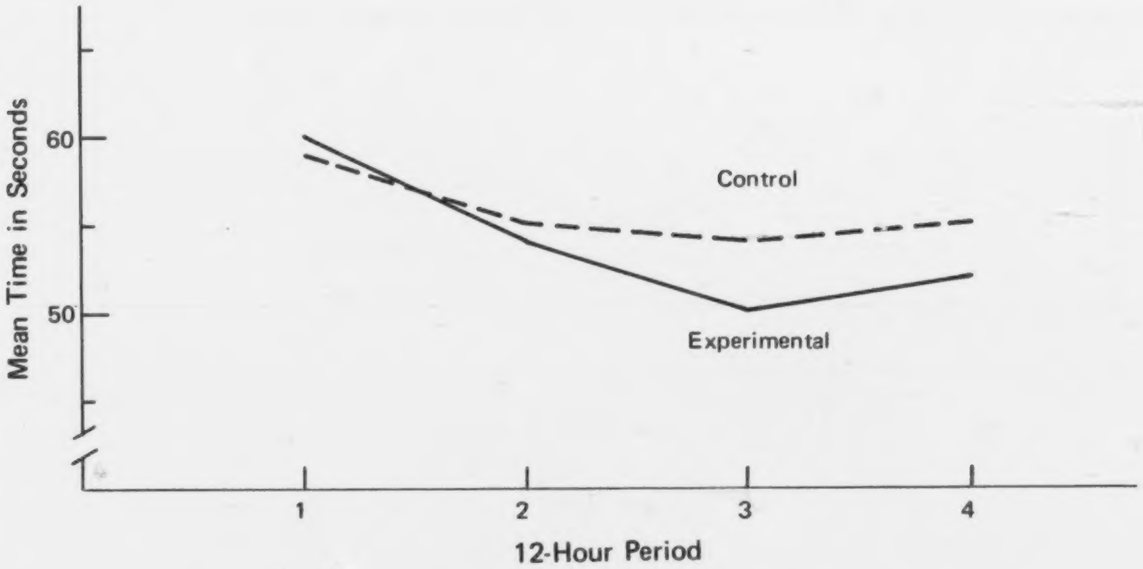

Figure 9

Mean Minefield Crossing Accuracy Scores: Successive 12-Hour Periods

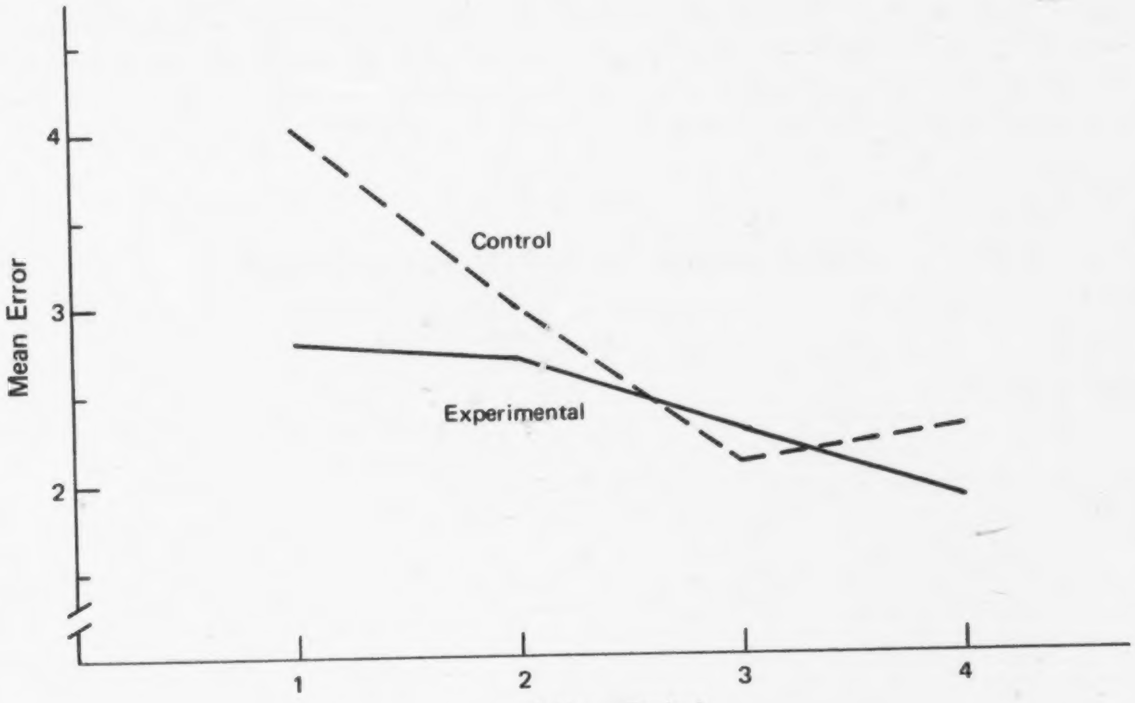

Figure 10

Mean Minefield Crossing Times: Successive 12-Hour Periods

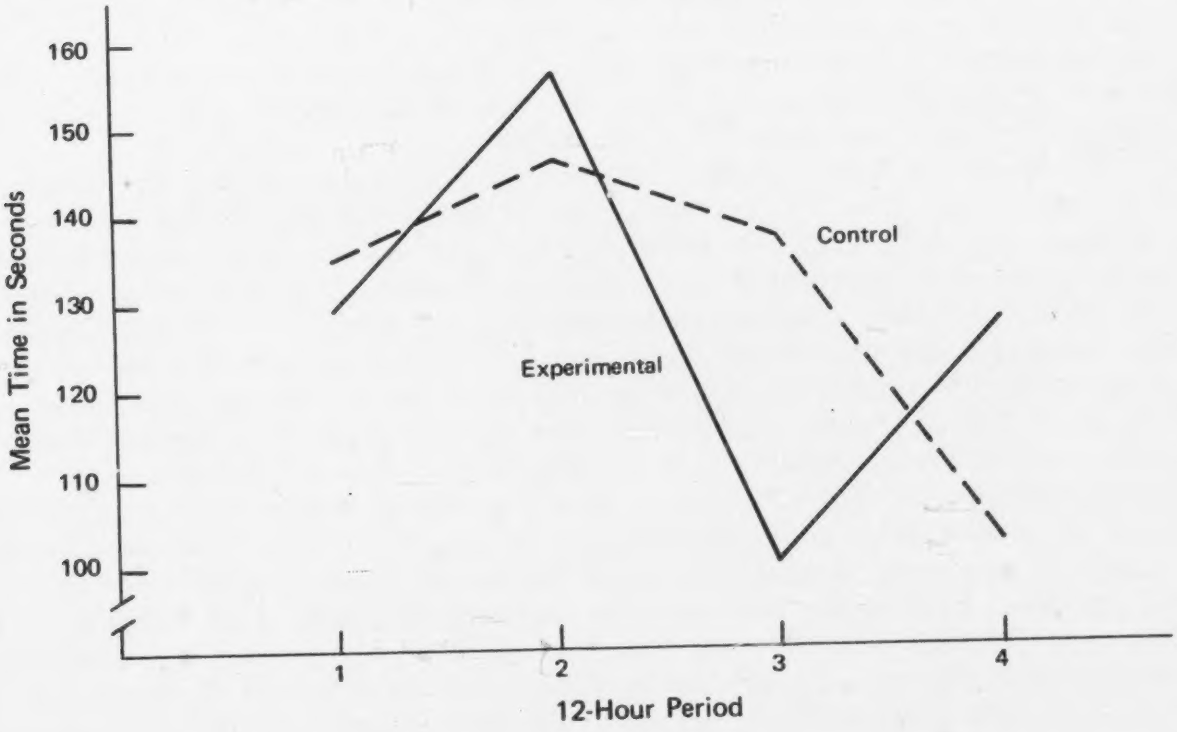

Figure 11

SURVEILLANCE EXERCISES

Passive Surveillance. The mean number of detections, in four presentations of each target, and the mean target-detection time for each type of target are given in Table 3. The scores obtained at night, periods 2 and 4, were depressed because of inclement weather and equipment malfunction, and scores are given only for the day periods, 1 and 3.

Table 3

Passive Surveillance Mean Detection Scores

Target	Group	12-hour Period					
		1		2[a]	3		4[a]
		Detections	Time[b]		Detections	Time[b]	
Tanks	C	3.3	25		3.2	24	
	E	2.6	28		2.8	28	
1/4-Ton	C	2.9	27		3.3	24	
	E	2.8	26		2.8	29	
Troops	C	2.0	32		3.0	26	
	E	1.8	33		2.2	32	

[a] Scores obtained during night periods 2 and 4 were invalidated by the effects of non-experimental variables and are not included in this table.

[b] In seconds.

The detection scores obtained with each type of target are plotted in Figure 12. The experimental group performed less well than the control group with all targets, but only the differences in scores obtained with the troop target were significant. The slight improvement shown by both groups from the first to the second day in the number of troop targets detected is also statistically significant.

The detection time scores plotted in Figure 13 show that the experimental group tended to take longer than the control group to detect the targets. The differences were small, however, and again only the differences in scores for the two groups obtained with the troops target were significant. The difference between groups in trends of the scores obtained with the ¼-ton vehicle targets was also significant. Considered together, the detection accuracy and time scores show that the control group performance improved, particularly with the smaller targets, from period to period but the experimental group improved much less or actually deteriorated. The differences in the performance of the two groups are small, however, and limited to the smaller and more difficult targets.

Moving Surveillance. For this exercise four machine guns with blank ammunition were positioned at points along a four-mile section of the tank route. The tanks passed this section twice during each complete circuit of the course. Each time they passed the tanks received fire from two of the positions. To maintain the element of surprise, the firing positions were different each time the tanks passed. The tank crew's task was to detect the gun emplacement and to indicate this by aiming the main gun at it during the day or illuminating it with the searchlight at night. The mean number of the four emplacements detected each 12-hour period is given in Table 4.

Mean Number Targets Detected, Passive Surveillance: Successive Daylight Periods

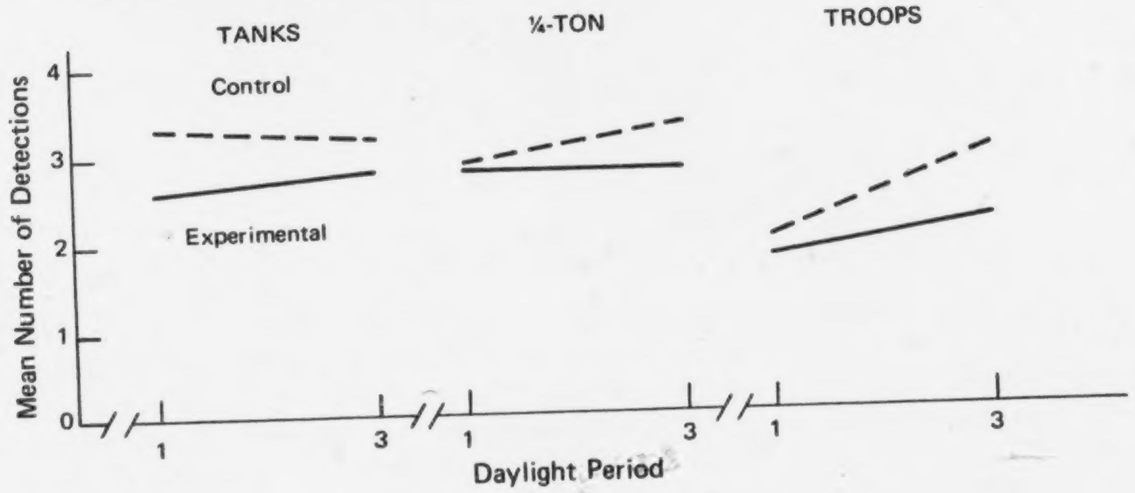

Figure 12

Mean Target Detection Times, Passive Surveillance: Successive Daylight Periods

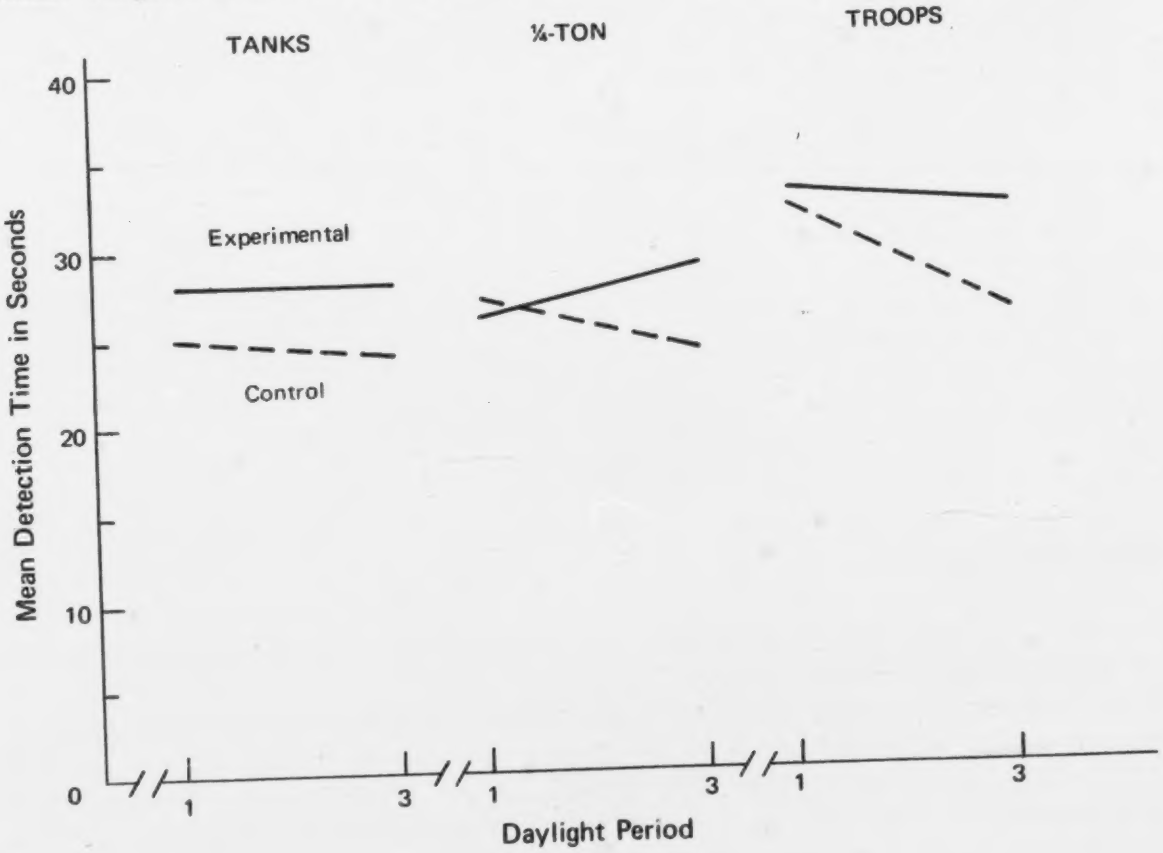

Figure 13

Table 4

Moving Surveillance Mean Detection Scores

Group	12-hour Period			
	1	2	3	4
C	2.0	2.8	3.6	3.2
E	2.6	1.8	2.2	2.8

The scores are plotted in Figure 14 where a significant difference between groups in the trends of the scores may be seen. Overall, the control group showed an improvement through the course of the experiment, whereas the experimental group showed an initial decrement and then a subsequent gradual improvement to the level of proficiency shown by them on the first day. The significant interaction between the groups and the hours of activity indicates that the efficiency of the experimental group was reduced by the extended period of duty although they did show a gradual improvement after the first day.

Mean Number Targets Detected, Moving Surveillance: Successive 12-Hour Periods

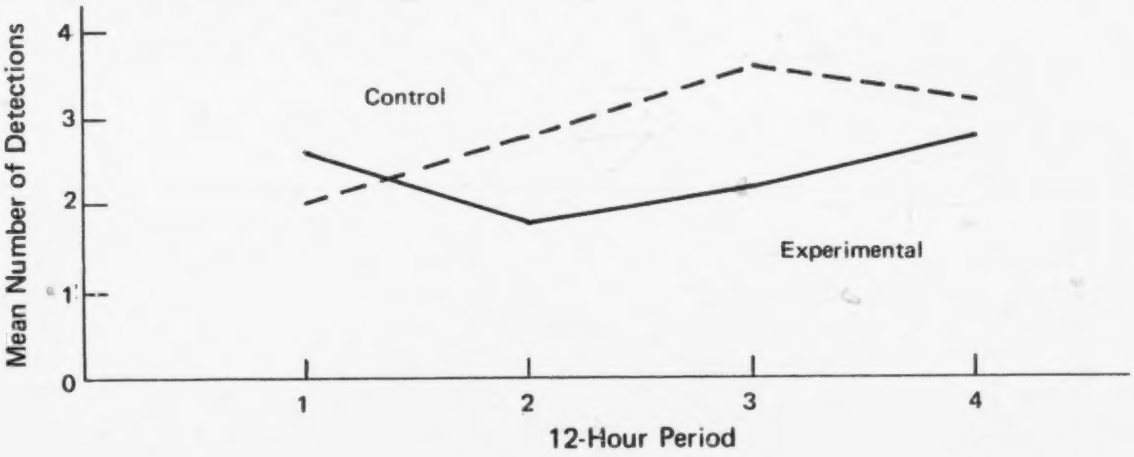

Figure 14

GUNNERY EXERCISES

The firing accuracy and time scores, where appropriate, for the gunnery exercises are given in Table 5 and plotted in Figures 15 to 21.

Phase I. In this exercise the tanks were stationary and the crews fired the main gun at stationary targets: standard 6′ x 6′ panel targets located at ranges of 700-900, 1100-1200, and 1500-1700 meters. The pattern of the target position is shown in Figure A-1 in Appendix A. The tank crews were issued three rounds per target, but to conserve ammunition they were instructed to cease fire if they scored a hit on the first or second round. In the scoring procedure, hit scores were weighted differentially, three points for a hit on round one, two for a hit on round two, one for a hit on round three, and zero if no hits were recorded. The scores obtained for each of the three targets were combined and the maximum mean score for a tank was taken as three points.

Table 5

Gunnery Exercises Mean Scores

Phase	Group	12-hour Period							
		1		2		3		4	
		Accuracy	Time[d]	Accuracy	Time[d]	Accuracy	Time[d]	Accuracy	Time[d]
Phase I[a]	C	1.1	41	0.5	32	1.1	31	0.9	46
Main Gun	E	0.9	33	0.7	57	0.9	36	0.6	48
Phase II[b]	C	0.4		0.5		0.9		1.1	
Coaxial Machine Gun	E	0.6		0.8		0.6		0.9	
Phase III[c]	C	.6	13	.3	25	1.2	9	1.4	15
Cal. 50 Machine Gun	E	.5	15	1.0	14	1.0	8	1.2	12
Phase III	C	.8	18	.9	16	1.4	14	1.5	12
Main Gun	E	1.3	18	1.0	16	1.2	14	1.5	13

[a] Maximum mean score for a tank—3 points.

[b] Poor, 5 hits; fair, 5 to 10; good, 10 to 15; excellent, 15 to 20 hits.

[c] Poor, 5 or less hits; fair, 6 to 19; good, 20 to 29; excellent, 30 to 50 hits.

[d] In seconds.

The mean accuracy and time to first round scores are plotted in Figures 15 and 16. As shown, the performances of the two groups did not differ. In general, the crews did not score a hit until the third round was fired during the day periods and were slightly, although not significantly, less accurate during the night periods. During the day periods about 35 seconds were required to fire the first round, and at night a significantly longer time, about 45 seconds, was required.

Overall, the results do not indicate any serious effect of the extended period of activity on firing the main gun. The lower accuracy and greater time scores obtained during the night periods probably reflect the difficulty of firing under artificial illumination and a possible loss in performance related to a conflict between the diurnal cycle of the subjects and the demand for alertness.

Phase II. Crews fired the coaxial machine gun from the tanks moving at 5 mph in Phase II of the gunnery exercises. The stationary targets were 4' x 20' panels at 200-, 300-, or 400-meters distance. The layout of the firing range is shown in Figure A-2 in Appendix A. During the night periods the targets were illuminated by tank-mounted searchlights.

Each tank fired one burst of 20 rounds at each of three targets. On the basis of observation of the tracer streams, scorers estimated the number of hits and rated the firing accuracy as poor, fair, good, or excellent, if the crew obtained less than 5, 5 to 10, 10 to 15, or 15 to 20 hits, respectively. For statistical analysis, the accuracy ratings, from lowest to highest, were assigned quantitative values of 0, 1, 2, or 3.

The results obtained with all targets were combined for each group and Figure 17 shows the mean rating scores per burst of 20 rounds. The performances of the two groups were quite similar. Neither performed well, because of lack of practice as well as equipment malfunction, but both showed some improvement during the course of the experiment. The variability of the scores was large, however, and the change in scores

Mean Hit Scores With Main Gun, Successive 12-Hour Periods: Tanks and Targets Stationary

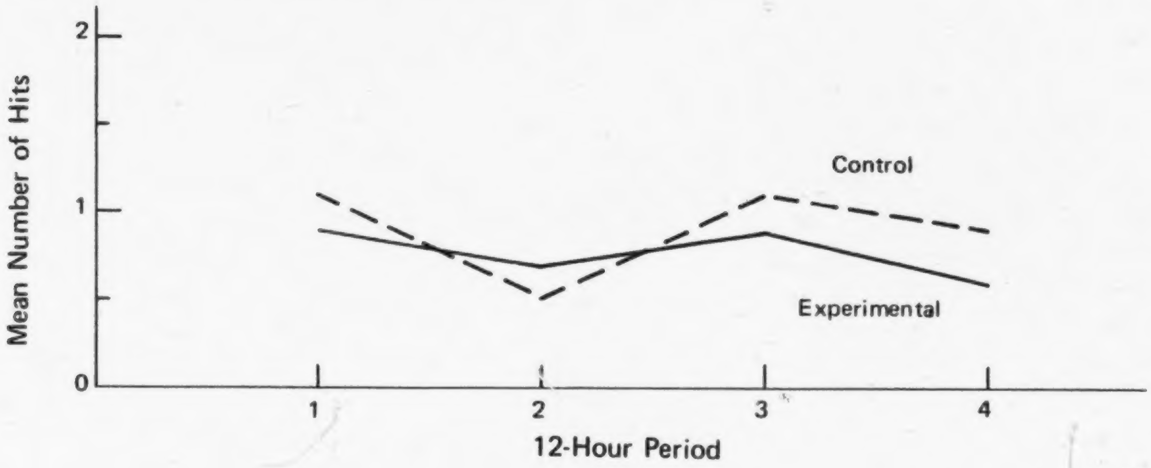

Figure 15

Mean Times to Fire First Round With Main Gun, Successive 12-Hour Periods: Tanks and Targets Stationary

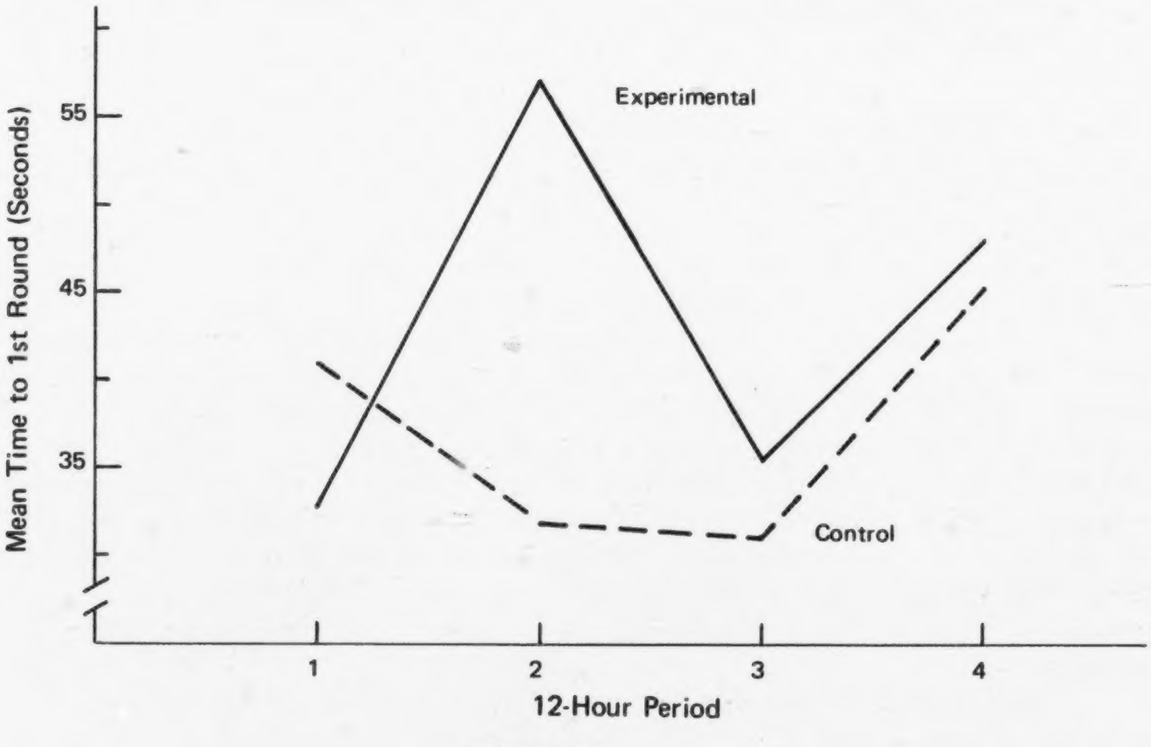

Figure 16

from period to period is not significant. The close similarity of the performances of the two groups suggests that the extended period of activity had no marked effect on the firing of the coaxial machine gun.

Phase III. Tanks were stationary and the crews fired the main gun and the caliber .50 machine gun at moving targets in Phase III. The targets for the machine gun were located at 600 meters and those for the main gun at 900 meters. Each crew fired six

Mean Rating of Hits Per 20-Round Burst With Coaxial Machine Gun, Successive 12-Hour Periods: Tanks Moving, Targets Stationary

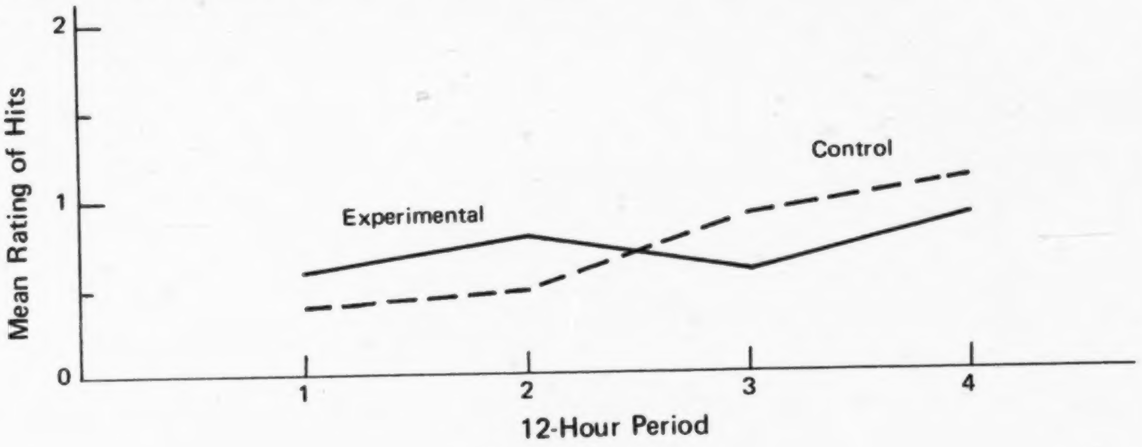

Figure 17

Mean Number of Hits Per Three Rounds With Main Gun, Successive 12-Hour Periods: Tanks Stationary, Targets Moving

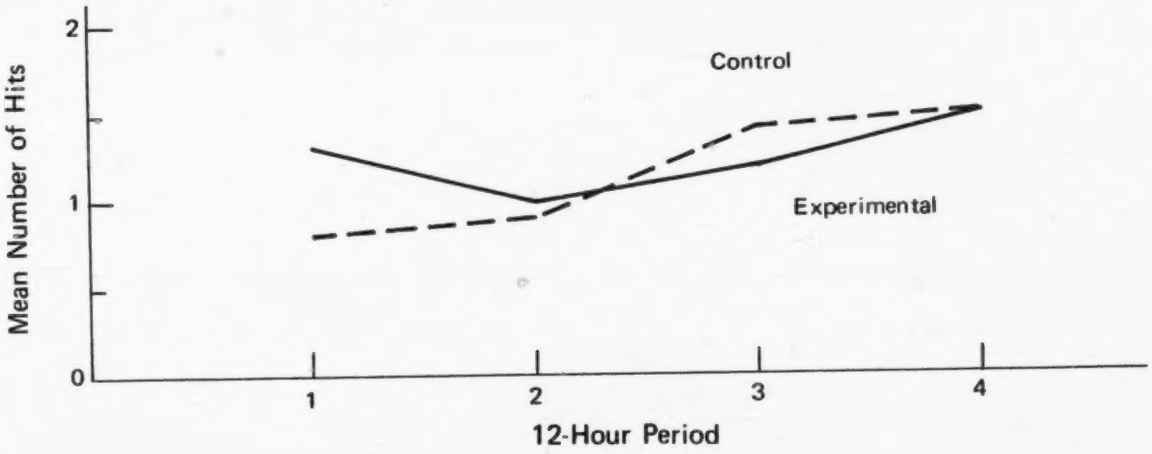

Figure 18

Mean Times to Fire First Round With Main Gun, Successive 12-Hour Periods: Tanks Stationary, Targets Moving

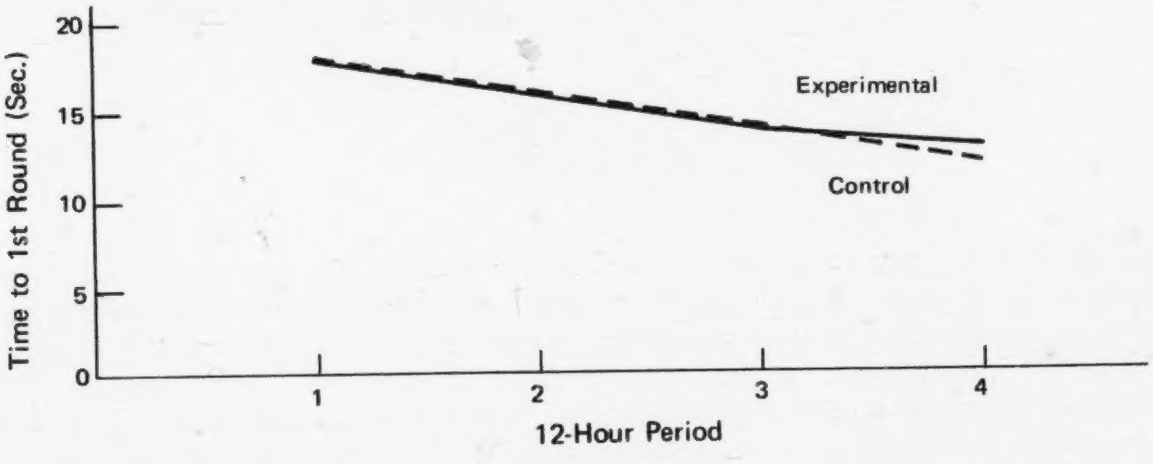

Figure 19

Mean Rating of Hits Per 50 Rounds With Caliber .50 Machine Gun, Successive 12-Hour Periods: Tanks Stationary, Targets Moving

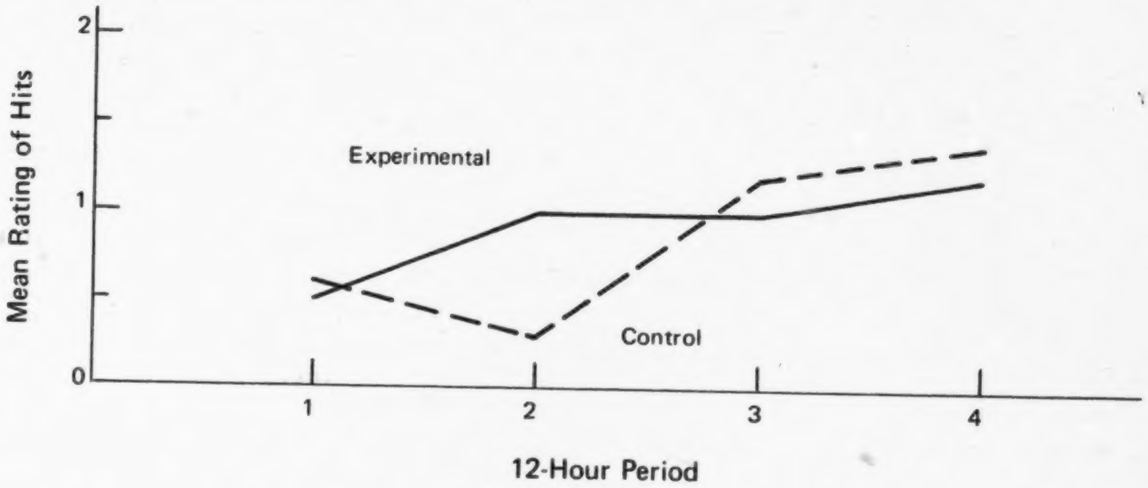

Figure 20

Mean Times to Fire First Round With Caliber .50 Machine Gun, Successive 12-Hour Periods: Tanks Stationary, Targets Moving

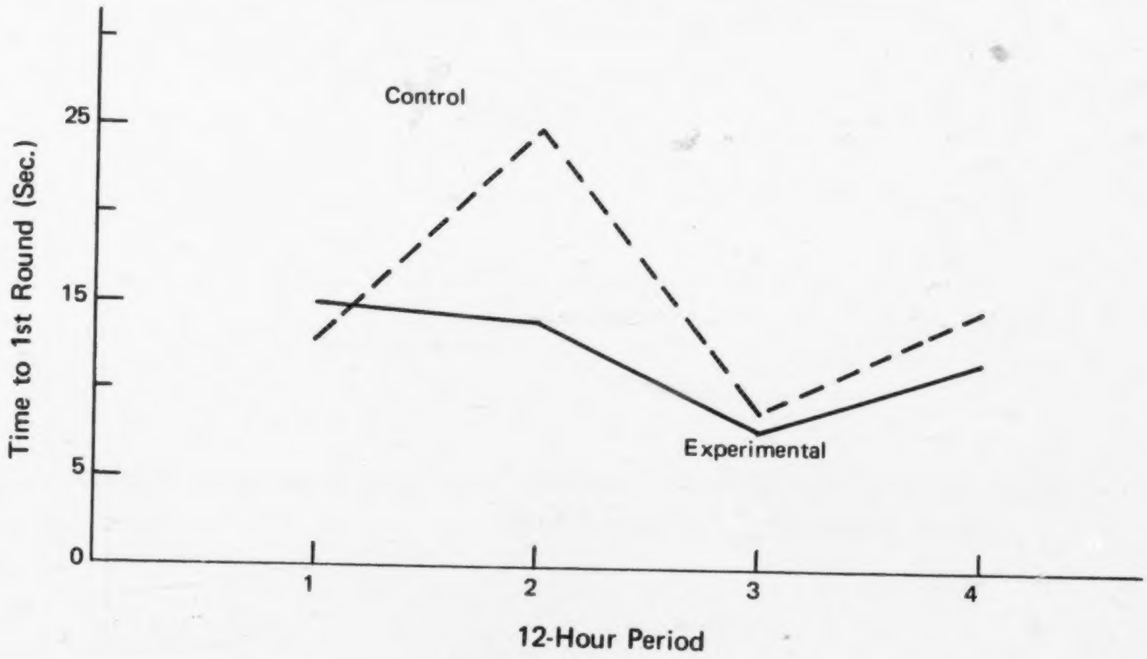

Figure 21

rounds with the main gun and was scored for time to fire the first round, as well as for accuracy. In Figures 18 and 19 the plotted data show that the performances of the two groups with the main gun were closely similar. The crews required about 15 seconds to fire the first round and, in general, scored but one hit with the 6 rounds. The trend of the scores suggests some improvement in both accuracy and time scores through the experiment, but again the variability of the scores was large and the differences were not statistically significant.

The crew fired two belts of 50 rounds with the caliber .50 machine gun and were scored for both accuracy and time to first round. The number of hits was estimated on the basis of observation of the tracer streams by scorers who rated the firing accuracy as poor, 5 or fewer hits; fair, 6 to 19; good, 20 to 29, or excellent, 30 to 50 hits. For statistical analysis the accuracy ratings, from lowest to highest, were assigned quantitative values of 0, 1, 2, or 3. The results of the exercises, shown in Figures 20 and 21, indicate no differences in the performance levels of the two groups, or any effect of the extended duty period. Figure 20 shows that during the course of the experiment the mean accuracy scores improved slightly from 5 or less to between 6 and 19 hits with 50 rounds fired, but the differences in the scores obtained during the different 12-hour periods are not statistically significant.

In the four gunnery exercises the accuracy scores for the control and experimental groups were quite similar, and the data suggest that the extended period of activity did not affect the crew's performances. The performance levels were quite low, however, and these results must be considered with caution since the low scores, particularly those obtained in the earlier 12-hour periods and due to nonexperimental variables, may have precluded the appearance of performance decrements during the course of the experiment.

MAINTENANCE EXERCISES

The mean maintenance scores are given in Table 6 and are plotted in Figures 22 and 23. The results show no differences between groups in levels or trends. The crews required eight to nine minutes to complete the maintenance procedures and usually performed all but one of seven checks correctly. The slight but significant decrement in the performance scores during the night periods probably reflects the effects of reduced visibility at night with flashlight illumination as well as possibly the conflict of the activity schedule with the diurnal cycle of the subjects. The results of the maintenance exercises do not indicate any serious effect of the extended period of activity upon the performance of maintenance tasks.

Table 6

Maintenance Exercises Mean Scores

Group	12-hour Period							
	1		2		3		4	
	Accuracy	Time[a]	Accuracy	Time[a]	Accuracy	Time[a]	Accuracy	Time[a]
C	5.9	533	5.6	664	6.2	519	6.3	544
E	5.6	448	5.0	516	6.0	514[b]	4.8	469

[a] In seconds.

[b] N=19

Mean Number Maintenance Tasks Correctly Performed: Successive 12-Hour Periods

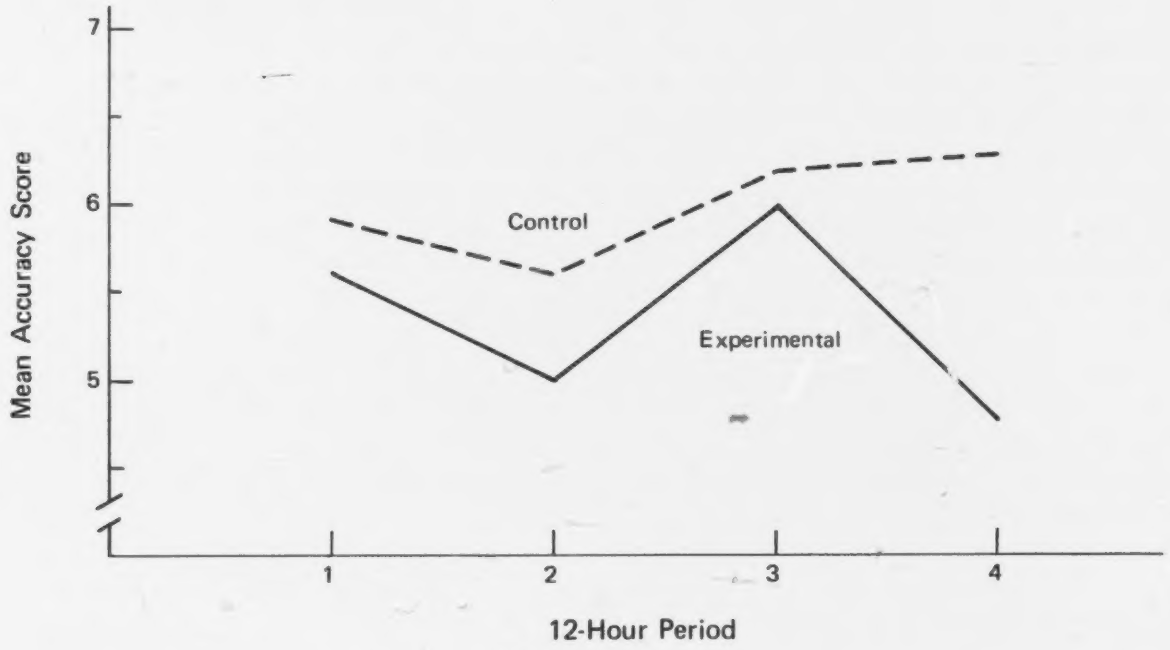

Figure 22

Mean Times for Performance of Maintenance Tasks: Successive 12-Hour Periods

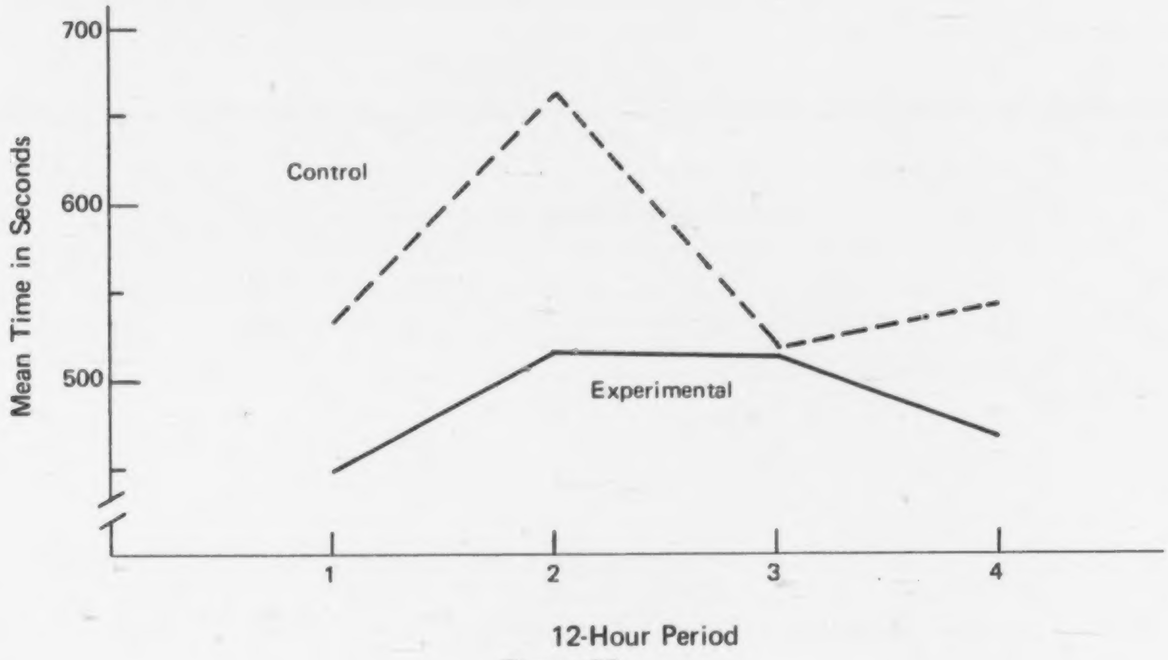

Figure 23

DISCUSSION

The primary concern of this research was the possible cumulative adverse effects of extended periods of field activity on selected areas of tank crew performance: communication, driving, surveillance, gunnery, and maintenance. Two of the basic activities tested—communication and maintenance—were found not to be affected to any significant degree by extending operations for a period of 48 hours. The effect on gunnery was unclear because of the initial low proficiency of the crews. Only the scores for passive surveillance and for some of the driving tasks indicated reasonably clear performance decrements that were probably due to lack of sleep.

COMMUNICATION AND MAINTENANCE

The communication exercises and to a small extent, the maintenance exercises, placed the greatest demands on the cognitive and short-term memory abilities of the subjects. The results for the RTP exercises, however, do not show the performance decrements typically found in previous studies of the effects of loss of sleep on the performance of tasks involving these abilities (3,4,5,6,7,8,9). A possible explanation is that the level of difficulty and demand was probably greater in these previous experiments than it was in the exercises included in the present study. Although ordinary communication performance was unaffected by the lack of sleep, communication procedures such as authentication, which place greater cognitive and perceptual demands on the operator, may be more seriously affected by the lack of rest, especially if the task is carried on for lengthy periods under pressure for speed in performance.

GUNNERY

The gunnery exercises included the behavioral element, reaction time, which has been shown to be sensitive to the effects of loss of sleep (4,5,10,11). But there were a number of variables in the gunnery exercises which probably acted to reduce the effects of the lack of rest and account, in part, for the lack of a performance decrement during the 48 hours. For example, physical activity and noise level, as well as the intrinsic interest of a task, have been identified as factors which may raise the level of motivation and arousal enough to overcome the effects of extended activity and loss of sleep (4,12,13,14,15). But because of equipment malfunction, insufficient training, and other problems, the accuracy scores were so low that evidence of performance decrements may have been precluded and it may only tentatively be concluded that gunnery is unaffected by loss of sleep.

SURVEILLANCE

The only marked performance differences between the control and experimental groups easily attributable to the effects of the extended period of activity were found in the surveillance exercises. The slower improvement and generally poorer performance of the experimental group in the moving surveillance exercises probably reflects a decrement in the alertness and motivation due to loss of sleep (5,12,16,17,18).

The performance of the experimental group was also significantly lower than that of the control group with the ¼-ton vehicle targets in the passive surveillance exercises. It is difficult, however, to accept this result as an important indication of an effect due to the lack of rest since the performance of the experimental group with the more difficult smaller troop targets did not also show a similar decrement.

DRIVING

The results of the driving exercises do not unequivocally support the conclusion that driving performance was affected by the prolonged period of activity. Only the results for the log obstacle and slalom exercises show reasonably clear, if small, performance decrements for the experimental group. In the slalom the experimental group was slightly less accurate, and in the log obstacle exercise they took more time but were about as accurate as the control group.

Such a trade-off of time to maintain accuracy is a common response of subjects performing self-paced tasks under conditions of fatigue or sleep loss (4,19,20). Crews may not apply the trade-off consistently, however. In the ditch crossing exercise, for example, the experimental group was not as proficient as the control group, but took significantly less time; and in the minefield exercise there were no differences in the performances of the two groups.

Considered together, the results obtained in the four driving exercises support the conservative conclusion that an extended period of activity results in significant, but relatively minor decrements in the performance of gross driving activities as used in the present experiment.

The results of the driving exercises contrast rather sharply with those obtained by Herbert and Jaynes (21), for example, who obtained decrements in performance after only an hour of driving, and by Drucker *et al.* (2), who found a decline in performance over 48 hours of activity, particularly during periods normally given to sleep. Both groups in the present field test showed improvement in driving performance during the course of the experiment. The improvement may reflect in part the fact that driving performance was measured during short test periods and the same driving exercises were repeated each 12-hour period.

Also important is the difference between the driving tasks used in this field test and those used by Drucker and others. A performance measurement that includes driving continuously for several hours or the manipulation of a simulator, as in Drucker's experiment, includes many characteristics of vigilance type of tasks in which performance is sensitive to the effects of extended activity (5,19,22). On the other hand, the specific tank driving measurement tasks used in this field test were periodic, of short duration, and presumably interesting; they also demanded relatively simple unitary perceptual-motor response patterns.

Also, there is little evidence of marked effects due to conflicts between the work time requirements and the subjects' diurnal cycle. Results obtained in the minefield, gunnery, and maintenance exercises do show significant differences in performance during the day and night work periods; but in these exercises the performance levels during the night periods were probably also affected by reduced visibility and the use of artificial illumination. Since the differences in performance scores between periods found in other exercises, such as the RTP exercises, although suggestive, were not significant, the most conservative conclusion is that the diurnal rhythm of the subjects did not affect performance significantly.

FACTORS IN PERFORMANCE DECREMENT

A salient feature, then, of the results of this investigation, is the general finding that tank crew performance in most of the test exercises may be sustained at a reasonable level of proficiency despite the requirement of 48 hours of continuous activity. These results corroborate informal comments by officers and men that tank crews can efficiently perform their jobs during periods of 36 hours or longer without sleep, and have often done so. The results also agree with the findings of previous investigations that performance efficiency may be sustained over relatively long periods of continuous activity (22,23,24,25).

The fact that field activity for 48 hours did not reduce proficiency appreciably should not be construed as conflicting seriously with previous research findings that prolonged activity produces decrements. In the course of studying this problem investigators have identified a number of factors which affect the degree to which performance decrements are found (e.g., 4,5,11,12,13). In general, these factors may be characterized as those affecting the general and momentary levels of motivation and arousal of the subjects.

In the field, the situation is real, and the level of motivation of a subject is probably higher than it is in a simulated environment. The penalties for failure to perform a driving task properly, for example, are much more severe in the field than in a simulator. Both the amount and the variety of sensory stimulation and muscular activity are usually much greater in the field. A variety of relatively short test exercises were used in this field exercise. Also, between the exercises there were periods during which activity could be reduced to a relatively low level. Thus, the subjects may have made a compensatory effort during the actual periods of test activity. Also, the test exercises chosen were to represent normal rather than particularly complex problem requirements, and offered a reasonable amount of intrinsic interest.

The importance of some of these variables was indicated by Drucker and his associates, and they suggested that the results of a field experiment might not show the marked performance decrements that were found in the laboratory (2). The present results confirm this forecast and clearly show that tank crews can remain active for 48 hours without marked loss of proficiency. Further, since previous investigations have shown that under certain conditions serious performance decrements may accompany extended periods of activity, we may tentatively conclude that such decrements may be offset or reduced under conditions which also produce reasonably high levels of motivation and arousal.

LIMITATIONS OF CONCLUSIONS

Limitations on the application of these conclusions must be recognized, of course. The relatively gross activities measured in the test exercises were chosen to represent present-day combat requirements and did not place high demands on the cognitive, perceptual, or motor skills of the subjects. The results of the experiment suggest only that tank crews can maintain adequate proficiency and meet these contemporary requirements during prolonged combat. As tanks, armament, and surveillance and communications equipment become more sophisticated, it can be assumed that future proficiency requirements in basic activities such as driving, gunnery, and surveillance will be increasingly stringent. And since the relatively gross activities tested in the present experiment were affected by the prolonged activity, it can be assumed that the more demanding future activities may be more seriously affected.

It should also be recognized that the present experiment stimulated a single effort type of combat problem and care must be exercised in extrapolating the results to a combat situation. At the beginning of the experiment the subjects were presumed to be well-rested and well-fed, and had not been subjected to a high stress environment. In a combat situation there is a high probability that immediately previous stress, both mental and physiological, and a sleep debt may already exist when the extended period of continuous duty begins. A number of experiments have shown that subjects may be more susceptible to the effects of sleep loss under these conditions (e.g., 26,27). For some personnel, the increased stress and arousal of combat may result in improved or maintained performance, but for many the cumulative effects of fatigue and debilitating conditions may be intensified by increased stress and accompanied by serious loss of ability to perform (28).

The following paragraphs summarize the results of the present research into the effects of sustained performance by tank crews for a 48-hour period.

(1) Activities that demand a protracted high level of alertness or complex perceptual-motor activity, such as the moving surveillance and some driving tasks, are the most sensitive to the adverse effects of loss of sleep.

(2) Under field conditions tank crews are able to perform present day communication, driving, surveillance, gunnery, and maintenance tasks without large performance decrements during a 48-hour period without sleep.

(3) Under field conditions, performance at night is not significantly affected by the subjects' diurnal rhythms.

(4) The results of this research do not indicate that changes in unit organization or tactical doctrine are necessary to accomplish continuous operations for periods up to 48 hours.

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AND
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Appendix A

EXERCISE PROCEDURE AND SCORE SHEETS

Annex 1: Radiotelephone Procedure Exercises

1. GENERAL

a. There are 6 radiotelephone procedure exercises. Each RTP exercise consists of six RTP items.

b. All 6 RTP exercises will be administered during the first 24 hours of operation. A second repetition of the same 6 RTP exercises will be conducted during the second 24 hours of the 48-hour operation.

c. The 6 RTP exercises will be given at three sites.

(1) Base Camp - RTP Sets No. 1 and 4.
(2) Passive Surveillance Range - RTP Sets No. 2 and 5.
(3) Gunnery Exercise Range (During PHASE III and IV when not on Firing Line) - RTP Sets No. 3 and 6.
(4) RTP Sets Nos. 1, 2, and 3 given during DAYLIGHT.
(5) RTP Sets Nos. 4, 5, and 6 given during DARKNESS.

d. RTP exercises numbers 1 (Daylight) and 4 (Darkness) are conducted at Base Camp (c(1) above). Procedure items 1 and 2 (of exercise Sets No. 1 and 4) require the radio net to be opened (item 1), and a radio check be conducted (item 2). The OIC will effect the opening of the net (item 1). Item 1 will be scored by the senior scorer, for the platoon. Item 2 will be effected by the OIC, also; however, Item 2 will be scored by each scorer on each tank, as will all subsequent RTP exercises.

e. Immediately after Item 2 has been scored, the scorer will direct the tank commander to place his radio on "interphone." All subsequent "transmissions" will be over the interphone during the RTP exercises, using normal RTP.

f. The scorer will act in the role of OIC, and will use his normal call-sign and suffix, except as noted in d, above.

g. Each tank commander will be required to write certain message transmissions from the scorer. The writing of the transmissions will be scored for accuracy of reception and accuracy of word sequences.

h. Each exercise will require approximately 15 minutes.

i. Each scorer will be issued a booklet containing the 6 RTP exercises.

j. Materials Required (See__________).

2. PROCEDURE

a. Each scorer will mount his assigned tank, and instruct the tank commander to TURN HIS RADIO ON.

b. Each scorer will connect his handset to the Loader's Intercommunication Set Control.

c. Each scorer will signal the OIC when the tank commander is prepared to begin. (Item 1, Sets 1 and 4, ONLY—see d, above).

d. Exercise Set 1, next page.

RTP Exercise - Set 1

Group ____________
Tank ____________

1. ESTABLISHING THE RADIO NET (Scored by senior scorer for the Group)

a. OIC Transmits: (Collective Call Sign)—THIS IS (Call Sign-Suffix)—OVER.

b. Each subordinate station answers this initial transmission of the OIC in numerical order.

		Score	
		Correct	Incorrect
1st Tank:	(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—OVER		
2nd Tank:	(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—OVER		
3d Tank:	(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—OVER		
4th Tank:	(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—OVER		
5th Tank:	(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—OVER		
	Total Correct		▨

NOTE: Should a station be unable to answer the collective call of the OIC in sequence, the delinquent station will answer as the last subordinate station. Credit will be given in this event, as a correct response. Each station must use the FULL CALL to be correct.

c. OIC having heard from all subordinate stations now calls the net collectively and indicates the net is now established:

OIC transmits: "(Collective Call Sign)—THIS IS (Call Sign-Suffix)—OUT."

2. RADIO CHECK

a. OIC transmits: (Collective Call Sign)—THIS IS (Call Sign-Suffix)—RADIO CHECK—OVER.

b. Each subordinate station answers this transmission of OIC in numerical order. (Senior scorer for the Group will score subordinate station's ORDER OF RESPONSE ONLY.)

		Score	
		Correct	Incorrect
1st Tank:	THIS IS (Call Sign-Suffix)—		
2d Tank:	THIS IS (Call Sign-Suffix)—		
3d Tank:	THIS IS (Call Sign-Suffix)—		
4th Tank:	THIS IS (Call Sign-Suffix)—		
5th Tank:	THIS IS (Call Sign-Suffix)—		
	Total Correct		▨

c. As each subordinate station responds, the scorer on each tank will score the transmission for that tank.

NOTE: Should the OIC's transmission be received Loud and Clear, the answer must be the proword "ROGER." Any other response, in order to be correct, must use the prowords in the following table:

Proword for Signal Strength	Proword for Readability
GOOD	READABLE
WEAK	DISTORTED
VERY WEAK	WITH INTERFERENCE

RTP - Set 1 *(Continued)*

d. Score Sheet

	Yes	No
(1) Station used the "ABBREVIATED CALL"		
(2) Station used correct PROWORD (See above)		
(3) Station ended transmission with proword "OVER."		
Total Correct		▨

3. WORDS TWICE

a. Scorer. Tells the tank commander: "You are having communication difficulties with station (Call Sign-Suffix). You will call station (Call Sign-Suffix) using the proword WORDS TWICE procedure. I will give you the message you will transmit. You have completed your normal preliminary calls. Do you understand the requirements?" (After receiving an affirmative) "The message is: AWAITING YOUR ORDER." (Scorer begins timing)

b. Score Sheet. (Tank Commander's Transmission)

	Yes	No
	▨	▨
(1) Call Sign-Suffix (Example: RED DOT 6)		
Call Sign-Suffix (RED DOT 6)		
(2) This is (Transmitted ONCE only)		
(3) Call Sign-Suffix (RED DOT 16)		
Call Sign-Suffix (RED DOT 16)		
(4) Words Twice		
Words Twice		
(5) Awaiting your order		
Awaiting your order		
(6) Over		
Over		
Total Correct		▨

Time ________________ .

4. SAY AGAIN WORD BEFORE/WORD AFTER

a. Scorer. Tells the tank commander: "I am going to send you a message. You will write the message down exactly as you receive it. You will respond to my transmission using radiotelephone procedure as required by the situation. Are you ready?" Upon being assured the TC understands the requirement, the scorer transmits the following:

(1) Scorer Transmits. (Call Sign-Suffix) THIS IS (Call Sign-Suffix)—MESSAGE FOLLOWS—ROAD TO KILLEEN WAS (*Cut Transmission)—PROCEED WITH CAUTION—OVER. (Scorer starts timing) *(MINED)

(2) Tank Commander. Writes the message and responds.

b. Score Sheet. (Tank Commander's Transmission)

	Yes	No
(1) (Call Sign-Suffix) THIS IS (Call Sign-Suffix)		
(2) SAY AGAIN		
(3) WORD		
(4) AFTER (OR BEFORE)		
(5) WAS (OR PROCEED)		
(6) OVER		
Total Correct		▨

Time ________________

RTP - Set 1 *(Continued)*

c. Scorer Transmits. (Call Sign-Suffix) THIS IS (Call Sign-Suffix)—I SAY AGAIN WORD AFTER (OR BEFORE) WAS (OR PROCEED)—MINED—OVER.

d. Tank Commander. "Rogers" the scorer's transmission and writes the word MINED in his written message.

e. Scorer. Takes the written message from the TC and scores it for Accuracy and Sequencing.

f. Score Sheet for TC's Writing Message (Check (✓) only the CORRECT responses. Do not indicate INCORRECT responses)

WRITTEN MESSAGE	Accuracy	Sequence
This		
is		
Call Sign		
Suffix		
Message		
Follows		
Road		
To		
Killeen		
Was		
Mined		
Proceed		
With		
Caution		
Over		
Total Correct		

5. ACKNOWLEDGEMENT

a. Scorer. Tells the tank commander: "I will transmit a message to you. You will respond as the situation requires."

b. Scorer Transmits. "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—MESSAGE FOLLOWS - TIME ONE FIVE ZERO NINER FIVE FIVE SIERRA—MOVE TO ALTERNATE POSITION - ACKNOWLEDGE—OVER." (Scorer begins timing).

c. Tank Commander. Transmits.

d. Score Sheet

	Yes	No
(1) THIS		
(2) IS		
(3) (CALL SIGN)		
(4) (SUFFIX)		
(5) WILCO		
(6) OUT		
Total Correct		▨

Time ________________ .

6. DO NOT ANSWER

a. Scorer. Tells the tank commander: "This is not a transmission. I will now give you a message, and instructions for transmitting the message. Write down this message: TIME ONE FIVE ZERO SEVEN THREE FIVE SIERRA—EXECUTE PLAN ALFA. You will now transmit that message to (Call Sign-Suffix) telling (Call Sign-Suffix) you do NOT want an answer. Do you understand the requirement?" When the TC says he understands, scorer begins timing.

b. Tank Commander. Transmits.

RTP - Set 1 *(Continued)*

c. Score Sheet.

	Yes	No
(1) (Call Sign-Suffix)		
(2) THIS IS		
(3) (Call Sign-Suffix)		
(4) MESSAGE FOLLOWS		
(5) DO NOT ANSWER		
(6) SENDS TIME GROUP		
(7) EXECUTE		
(8) PLAN		
(9) ALFA		
(10) I		
(11) SAY		
(12) AGAIN		
(13) (Call Sign-Suffix)		
(14) THIS IS		
(15) (Call Sign-Suffix)		
(16) MESSAGE FOLLOWS		
(17) DO NOT ANSWER		
(18) TIME GROUP		
(19) EXECUTE		
(20) PLAN		
(21) ALFA		
(22) OUT		
Total Correct		

Time ________________

END OF RTP - SET 1

RTP Exercise - Set 2[1]

1. PHONETIC ALPHABET

a. Scorer. The scorer will give the tank commander a written message exactly as it is written below. Then tells the tank commander: "You will send this message to (Call Sign-Suffix) using proper radiotelephone procedure. Do you understand the requirement?" Upon the TC's affirmative, the scorer begins timing.

SCORING NOTE: If the TC uses the proword "I SPELL" it is correct.

b. Message. "MY POSITION IS - VJ - GQ - TK - OVER"

c. Tank Commander. Transmits.

d. Score Sheet.

	Yes	No
(1) (Call Sign-Suffix)		
(2) THIS IS		
(3) (Call Sign-Suffix)		
(4) MY		
(5) POSITION		
(6) IS		
(7) VICTOR		
(8) JULIET		
(9) GOLF		
(10) QUEBEC		
(11) TANGO		
(12) KILO		
(13) OVER		
Total Correct		▨
(14) Did TC use proword "I SPELL"?		

Time ________________.

2. TIME AND COORDINATES

a. Scorer. Tells the tank commander: "You will write down the message I will give you. Then respond to the message by using radiotelephone procedure as required by the situation. Here is the message.

(Call Sign-Suffix) THIS IS (Call Sign-Suffix) REPORT THE TIME YOU ARRIVED AT PRESENT POSITION - BREAK - REPORT YOUR LOCATION USING SIX DIGIT COORDINATES—OVER." (Scorer begins timing.)

b. Tank Commander. Transmits.

c. Score Sheet.

d. Scorer. Asks tank commander for his written message, and scores it for Accuracy and Sequencing.

e. Score Sheet.

3. I SPELL

a. Scorer. Tells the tank commander: "This is not a transmission. I am going to give you instructions for your next requirement. I will hand you a message. You will send the message to the station indicated, and you will spell the word written in capital letters. Do you understand?" The scorer hands a copy of the following message to the tank commander.

"Transmit to (Call Sign-Suffix)—enemy armor sighted in vicinity of Pyrongyang." (Scorer begins timing)

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[1] RTP exercises 2-5 are presented in an abbreviated form, omitting the details of the scoring sheets after the first sample. Details of the exercises are available from HumRRO Division No. 2, Fort Knox, Kentucky 40121.

b. Tank Commander. Transmits.

c. Score Sheet.

4. ABBREVIATIONS

a. Scorer. The scorer writes the following message, gives it to the tank commander and says, "You will transmit this message to (Call Sign-Suffix)." (Scorer begins timing.)

b. Message. "AIR HAS REPORTED TWO ENEMY TANKS NEAR KILLEEN CATHOLIC CH. AREA—COORDINATES 0 24889—."

c. Tank Commander. Transmits.

d. Score Sheet.

5. SAY AGAIN ALL AFTER/ALL BEFORE

a. Scorer. Tells tank commander: "I will now transmit a message to you. You will answer my transmission using radiotelephone procedure required by the situation. You will also write the message down as you receive it. Do you understand?" When the TC indicates he understands, the scorer will send the following message (omitting the part in capital letters. Scorer will cut off transmission, pausing required transmission time).

Message: "(Call Sign-Suffix) This is—(Call Sign-Suffix)—hold your position—the enemy is trying to (FORD COWHOUSE CREEK)—OVER."

(Scorer begins timing).

b. The Tank Commander. Transmits.

c. Score Sheet.

d. Scorer. Scorer responds to the Tank Commander with this transmission: "Call Sign-Suffix) THIS IS (Call Sign-Suffix)—I SAY AGAIN ALL AFTER TO—FORD COWHOUSE CREEK—OVER."

e. Tank Commander. "ROGERS" the transmission.

f. Scorer. The scorer asks the TC for the written message, and scores it for Accuracy and Sequency. (Check (√) only the CORRECT responses)

g. Score Sheet. (Written Message)

6. RELAY TO/FROM

a. Scorer. Tells tank commander: "You have a message for (Call Sign-Suffix) (example: Red Dog 26) that has to be relayed through (Call Sign-Suffix) (example: Red Dog 16). The message is: CHOPPER WILL PICK UP PRISONERS. You have completed the preliminary call to (Call Sign-Suffix) (Red Dog 16), and are now ready to transmit your message using proper radiotelephone procedure. Do you understand the requirements?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells tank commander: "Transmit your message" (Begins timing.)

d. Tank Commander. Starts transmitting the message.

e. Score Sheet.

END OF RTP - SET 2

RTP Exercise - Set 3

1. SAY AGAIN/I SAY AGAIN

a. Scorer. Tells the tank commander: "You will transmit the following message to my (Scorer's) station (Call Sign-Suffix). You will use the full call. The message is: ROAD TO KILLEEN CLEAR—PROCEED ON MISSION—OVER. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells the TC: "Transmit the message."

d. Tank Commander. Begins transmission.

e. Score Sheet.

f. Scorer. The scorer transmits the following to the tank commander: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—SAY AGAIN—OVER." (Scorer begins timing.)

g. Tank Commander. Transmits.

h. Score Sheet.

2. CORRECTION

a. Scorer. Tells tank commander: "You will transmit the following message to (Call Sign-Suffix). The message: ENEMY REPORTED NORTH OF KILLEEN. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells the TC: "Begin your transmission"

d. Tank Commander. Transmits message.

e. Score Sheet.

f. Scorer: The Scorer answers the TC's transmission with: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—ROGER—OUT." Then the scorer tells the tank commander: "Your last transmission needs to be corrected, it should be south of Killeen, not north of Killeen. Correct your last transmission using proper radiotelephone procedure. Do you understand?"

g. Tank Commander. Indicates he understands.

h. Scorer. Tells the tank commander: "Start transmitting." (Scorer begins timing.)

i. Score Sheet.

j. Scorer. Answers transmission with: "THIS IS (Call Sign-Suffix)—ROGER—OUT."

3. READ BACK/I READ BACK

a. Scorer. Tells tank commander: "I will send you a message. You will write the message down, and then you will answer my message using proper radiotelephone procedure. Do you understand?"

b. Tank Commander. Indicates he understands.

c. Scorer. Sends the following message: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—READ BACK—ROUTINE—ENEMY MOVING IN DIRECTION OF KILLEEN FROM SOUTH—OVER." (Scorer begins timing.)

d. Tank Commander. Starts transmission.

e. Score Sheet.

4. THAT IS CORRECT/WRONG

a. Scorer. Tells the tank commander: "Assume you called station (Call Sign-Suffix) and transmitted a READ BACK message. Further assume that station (Call Sign-Suffix) read back your message without error. You will now respond to station (Call Sign-Suffix) using proper radiotelephone procedure. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells the TC "Transmit your response" (Begins timing)

d. Score Sheet.

RTP - Set 3 *(Continued)*

5. VERIFY/I VERIFY

a. Scorer. The scorer will write the following message on a piece of paper: COVER COWHOUSE CREEK CROSSING UNTIL 1400 HOURS. Scorer then tells the tank commander: "I will give you a written message. You will transmit the message to me (Call Sign-Suffix). I will answer your transmission. Then, you will respond to my transmission using proper radiotelephone procedure. Do you understand?"

b. Tank Commander. Indicates he understands.

c. Scorer. Gives written message to the TC. Tells the TC: "Here is the message. Transmit it to me."

d. Tank Commander. Transmits message.

e. Score Sheet.

f. Scorer. The scorer responds to this message with the following transmission: "(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—VERIFY WORD AFTER CREEK—OVER." (Begins timing.)

g. Tank Commander. Transmits.

h. Score Sheet.

i. Scorer. Answers: "THIS IS (Call Sign-Suffix)—ROGER—OUT."

6. WILCO

a. Scorer. Tells the tank commander: "I will send a message to you. You will write the message down, and answer using proper radiotelephone procedure. Do you understand?"

b. Tank Commander. Indicates he understands.

c. Scorer. Transmits the following message to the tank commander: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix) PROCEED TO OBJECTIVE RED—MOVEMENT WILL BE COMPLETED AT TIME ZERO SIX ZERO ZERO ROMEO—OVER." (Begins timing.)

d. Tank Commander. Transmits.

e. Score Sheet.

f. Scorer. Asks tank commander for his written message. Scorer will score the written message for Accuracy and Sequence. Score with a check (√) the correct responses only.

END OF RTP - SET 3

RTP Exercise - Set 4

1. ESTABLISHING THE RADIO NET (Scored by senior scorer of Group.)

a. OIC Transmits: (Collective Call Sign)—THIS IS (Call Sign-Suffix)—OVER.

b. Each subordinate station answers this initial transmission of the OIC in numerical order.

NOTE: Should a station be unable to answer the collective call of the OIC in sequence, the delinquent station will answer as the last subordinate station. Credit will be given in this event, as a correct response. Each station must use the FULL CALL to be correct.

c. OIC having heard from all subordinate stations now calls the net collectively and indicates the net is established. OIC transmits: "(Collective Call Sign)—THIS IS (Call Sign-Suffix)—OUT."

2. RADIO CHECK

a. OIC transmits: "(Collective Call)—THIS IS (Call Sign-Suffix)—RADIO CHECK—OVER".

b. Each subordinate station answers this transmission of OIC in numerical order (Senior scorer for Group will score subordinate station's ORDER OF RESPONSE only).

c. As each subordinate station responds, the scorer on each tank will score the transmission for that tank.

NOTE: Should the OIC's transmission be received Loud and Clear, the answer must be "ROGER". Any other response, in order to be correct, must use the prowords in the following table:

Proword for Signal Strength	Proword for Readability
GOOD	READABLE
WEAK	DISTORTED
VERY WEAK	WITH INTERFERENCE

d. Score Sheet.

3. WORDS TWICE

a. Scorer. Tells the tank commander: "You are having communication difficulties with station (Call Sign-Suffix). You will call station (Call Sign-Suffix) using the proword WORDS TWICE procedure. I will give you the message to transmit. You have completed your normal preliminary calls. Do you understand the requirement?" (After receiving an affirmative). "The message is: GIVE ME A TIME CHECK." (Scorer begins timing.)

b. Score Sheet. (Tank Commander's Transmission)

4. SAY AGAIN WORD BEFORE/WORD AFTER

a. Scorer. Tells the tank commander: "I am going to send you a message. You will write the message down exactly as you receive it. You will respond to my transmission using radiotelephone procedure as required by the situation. Are you ready?" Upon being assured the TC understands the requirement, the scorer transmits the following:

(1) Scorer Transmits: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—MESSAGE FOLLOWS—BRIDGE ON (*Cut transmission) CREEK DESTROYED—OVER. (Scorer begins timing) *(COWHOUSE)

(2) Tank Commander. Writes the message and responds.

b. Score Sheet (Tank Commander's Transmission)

c. Scorer Transmits. (Call Sign-Suffix) THIS IS—(Call Sign-Suffix)—I SAY AGAIN WORD AFTER (or BEFORE) ON (or CREEK) COWHOUSE—OVER.

d. Tank Commander. "ROGERS" the scorer's transmission, and writes the word COWHOUSE in his written message.

e. Scorer. Takes the written message from the TC and scores it for Accuracy and Sequencing.

f. Score Sheet for TC's Written Message.

5. ACKNOWLEDGEMENT

a. Scorer. Tells the tank commander: "I will transmit a message to you. You will respond as the situation requires."

b. Scorer Transmits. "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—MESSAGE FOLLOWS—REMAIN IN PRESENT POSITION—ACKNOWLEDGE—OVER" (Scorer begins timing)

c. Tank Commander. Transmits.

d. Score Sheet.

6. DO NOT ANSWER

a. Scorer. Tells tank commander: "This is not a transmission. I will give you a message, and instructions for transmitting the message. Write this message down: TIME TWO THREE ZERO EIGHT TWO FIVE SIERRA—HOLD YOUR FIRE—. You will now transmit that message to (Call Sign-Suffix) telling (Call Sign-Suffix) you do NOT want an answer. Do you understand the requirement?" When the TC says he understands, scorer begins timing.

b. Tank Commander. Transmits.

c. Score Sheet.

END OF RTP - SET 4

RTP Exercise - Set 5

1. PHONETIC ALPHABET

a. Scorer. The scorer will give the tank commander a written message exactly as it is written below. Then tells the tank commander: "You will send this message to (Call Sign-Suffix) using proper radiotelephone procedure. Do you understand the requirement?" Upon receiving the TC's affirmative, the scorer begins timing.

b. Message. "MY POSITION IS—KJ—WF—IL—OVER"

c. Scoring Note. If TC uses "I SPELL" it is incorrect.

d. Tank Commander. Transmits.

e. Score Sheet.

2. TIME AND COORDINATES

a. Scorer. Tells the tank commander: "You will write down the message I will give you. Then respond to the message by using radiotelephone procedure as required by the situation. Here is the message:

> (Call Sign-Suffix) THIS IS (Call Sign-Suffix)—REPORT TIME YOU DEPARTED BASE CAMP—BREAK—REPORT PRESENT POSITION USING SIX DIGIT COORDINATES—OVER." (Scorer begins timing.)

b. Tank Commander. Transmits.

c. Score Sheet.

d. Scorer. Asks tank commander for his written message, and scores it for Accuracy and Sequence.

e. Score Sheet.

3. I SPELL

a. Scorer. Tells the tank commander: "This is not a transmission. I am going to give you instructions for your next requirement. I will hand you a message. You will send the message to the station indicated, and you will spell the word written in capital letters. Do you understand?" The scorer hands a copy of the following message to the tank commander.

"Transmit to: (Call Sign-Suffix)—four medium tanks sighted near MUSCKATUCK." (Scorer begins timing.)

b. Tank Commander. Transmits.

c. Score Sheet.

4. ABBREVIATIONS

a. Scorer. The scorer writes the following message, gives it to the tank commander and says, "You will transmit this message to (Call Sign-Suffix)." (Scorer begins timing.)

b. Message: "CAVALRY UNITS REPORT ENEMY TROOPS NEAR KILLEEN CEM. AREA—COORDINATES 005915—."

c. Tank Commander. Transmits.

d. Score Sheet.

5. SAY AGAIN ALL AFTER/ALL BEFORE

a. Scorer. Tells tank commander: "I will now transmit a message to you. You will answer my transmission using radiotelephone procedure required by the situation. You will also write the message down as you receive it. Do you understand?" When the TC indicates he understands, the scorer will send the following message (omitting the part in capital letters. Scorer will cut-off the transmission, pausing the required transmitting time).

> Message: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—Road to Killeen Is (CLEAR—PROCEED WITH CAUTION)—OVER."

(Scorer begins timing).

b. Tank Commander. Transmits.

c. Score Sheet.

d. Scorer. Scorer responds to the tank commander with this transmission: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix) I SAY AGAIN ALL AFTER IS—CLEAR—PROCEED WITH CAUTION—OVER.

e. Tank Commander. "ROGERS" the transmission.

f. Scorer. The scorer asks the TC for the written message, and scores it for Accuracy and Sequence. (Check (√) only the CORRECT responses).

g. Score Sheet.

6. RELAY TO/FROM

a. Scorer. Tells tank commander: "You have a message for (Call Sign-Suffix) (Example: Hot Shot 26) that has to be relayed through (Call Sign-Suffix) (Example: Hot Shot 16). The message is: CONTINUE ON YOUR PRESENT MISSION. You have completed your preliminary call to (Call Sign-Suffix) (Example: Hot Shot 16), and are now ready to transmit your message using proper radiotelephone procedure. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells tank commander: "Transmit your message." (Begins timing.)

d. Tank Commander. Starts transmitting message.

e. Score Sheet.

END OF RTP - SET 5

RTP Exercise - Set 6

1. SAY AGAIN/I SAY AGAIN

a. Scorer. Tells the tank commander: "You will transmit the following message to my (Scorer's) station (Call Sign-Suffix). You will use the full call. The message is: COWHOUSE CREEK IS FLOODED—PROCEED WITH CAUTION—OVER. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells the TC: "Transmit the message"

d. Tank Commander. Begins transmission.

e. Score Sheet.

f. Scorer. The scorer transmits the following to the tank commander: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix). SAY AGAIN-OVER." (Scorer begins timing.)

g. Tank Commander. Transmits.

h. Score Sheet.

2. CORRECTION

a. Scorer. Tells tank commander: "You will transmit the following message to (Call Sign-Suffix). The message: TRUCK CONVOY WILL ARRIVE 1600 HOURS. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells the TC: "Begin your transmission."

d. Tank Commander. Transmits message.

e. Score Sheet.

f. Scorer. The scorer answers the TC's transmission with: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—ROGER—OUT". Then the scorer tells the tank commander: "Your last transmission needs to be corrected, it should be 1800 not 1600. Correct your last transmission using proper radiotelephone procedure. Do you understand?"

g. Tank Commander. Indicates he understands.

h. Scorer. Tells the TC: "Start transmitting. (Scorer begins timing.)

i. Score Sheet.

j. Scorer. Answers transmission with: "THIS IS (Call Sign-Suffix) ROGER—OUT."

3. READ BACK/I READ BACK

a. Scorer. Tells tank commander: "I will send you a message. You will write the message down, and then you will answer my message using proper radiotelephone procedure. Do you understand?"

b. Tank Commander. Indicates he understands.

c. Scorer. Sends the following message: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—READ BACK—MESSAGE FOLLOWS—REPORT MINED AREA IN SIX DIGIT COORDINATES—OVER." (Scorer begins timing.)

d. Tank Commander. Starts transmission.

e. Score Sheet.

4. THAT IS CORRECT/WRONG

a. Scorer. Tells the tank commander: "Assume you called station (Call Sign-Suffix) and transmitted a READ BACK message. Further assume that station (Call Sign-Suffix) read back your message without error. You will now respond to station (Call Sign-Suffix) using proper radiotelephone procedure. Do you understand the requirement?"

b. Tank Commander. Indicates he understands.

c. Scorer. Tells the TC: "Transmit your response." (Begins timing.)

d. Score Sheet

5. VERIFY/I VERIFY

a. Scorer. The scorer will write the following message on a piece of paper: HOLD YOUR PRESENT POSITION UNTIL 1300 HOURS. Scorer then tells the tank commander: "I will give you a written message. You will transmit the message to me (Call Sign-Suffix). I will answer your transmission. Then, you will respond to my transmission using proper radiotelephone procedure. Do you understand?"

b. Tank Commander. Indicates he understands.

c. Scorer. Gives written message to the TC. Tells the TC: "Here is the message. Transmit it to me."

d. Tank Commander. Transmits message.

e. Score Sheet.

f. Scorer. The scorer responds to this message with the following transmission: "(Call Sign-Suffix)—THIS IS (Call Sign-Suffix)—VERIFY WORD AFTER POSITION—OVER." (Begins timing.)

g. Tank Commander. Transmits.

h. Score Sheet.

i. Scorer. Answers: "THIS IS (Call Sign-Suffix)—ROGER—OUT."

6. WILCO

a. Scorer. Tells the tank commander: "I will send a message to you. You will write the message down, and answer using proper radiotelephone procedure. Do you understand?"

b. Tank Commander. Indicates he understands.

c. Scorer. Transmits the following message to the tank commander: "(Call Sign-Suffix) THIS IS (Call Sign-Suffix)—PROCEED TO OBJECTIVE GREEN—MOVEMENT WILL BEGIN AT TIME ZERO FIVE FOUR FIVE—ROMEO—OVER." (Begins timing.)

d. Tank Commander. Transmits.

e. Score Sheet.

f. Scorer. Asks tank commander for his written message. Scorer will score the written message for Accuracy and Sequence.

END OF RTP - SET 6

Annex 2: Driving Exercises

Log Obstacle

Instructions for Scorers

1. There will be one scorer for the exercise. He will have pencils, Score Sheets, a stopwatch, and, at night, a flashlight.
2. The scorer will stop the tanks at a previously prepared position 25 yards in front of the obstacle, and proceed as follows:
   a. Say to the commander of the first tank, "When I say 'Begin,' drive across the log obstacle. After you have crossed the obstacle, proceed according to your instructions. Ready. Begin!"
   b. Start the stopwatch at the word "Begin!"
   c. Walk beside the tank, at a safe distance, as it crosses the obstacle, and mark the Score Sheet with a check (√) in the blank space after "yes" or "no," as appropriate, for each of the items 1 through 6.
   d. As soon as the tank breaks contact with the obstacle, stop the watch and record the time, to the nearest second, in the blank space in item 7.
   e. Reset the watch at "0," and record in the "Remarks" section any unusual event(s) which may have affected the performance. Print the scorer's name in the appropriate space on the Score Sheet.

SCORE SHEET: Log Obstacle

Date: ______ Group No.: ______ Crew No.: ______ Time: ______

1. Full stop before hitting obstacle.	yes ___	no ___
2. Moves forward slowly until tracks make contact.	yes ___	no ___
3. Accelerates until on top of obstacle.	yes ___	no ___
4. Decelerates on top of obstacle.	yes ___	no ___
5. Hits ground without bouncing.	yes ___	no ___
6. Moves forward slowly until clear of obstacle.	yes ___	no ___

7. Time from start signal to #6: ____ seconds

Score is number of "yes" column checks. Total: ____________

Remarks:
Scorer: ____________________

Ditch

Instructions for Scorer

1. There will be one scorer for the exercise. He will have pencils, score sheets, a stopwatch, and, at night, a flashlight.
2. The scorer will stop the tank at a previously marked position, approximately 35 yards in front of the ditch, and proceed as follows:
    a. Order the tank to move to a previously marked position, 25 yards in front of the ditch, and halt.
    b. Walk beside the tank, and, when it has halted, say to the tank commander "When I say 'Begin,' drive through the ditch. After you have crossed the ditch, continue as you have been ordered to do. Ready. Begin!"
    c. Start the stopwatch at the word "Begin!"
    d. Walk beside the tank, at a safe distance, as it traverses the ditch, and mark the Score Sheet with a check mark (√) in the blank space after "yes" or "no," as appropriate, for each of the items 1 through 5.
    e. As soon as the tank hits the ground after clearing the rear lip of the ditch, stop and watch and record the time in the blank space in item 6, to the nearest second.
    f. Reset the watch at "0," and record in the "Remarks" section any unusual events which might have affected the performance. Print the scorer's name in the appropriate space on the Socre Sheet.
    g. Return to the start point and follow the procedure above until all tanks have completed the exercise.
3. Procedure will be the same, day and night, except that the scorer will use a flashlight at night whenever it is required, and tanks will use BOD.

SCORE SHEET: Ditch

Date: ________ Group No.: ________ Crew No.: ________ Time: ________

1. Shifts to low before entering ditch. yes ___ no ___
2. Decelerates until tank hits botom. yes ___ no ___
3. Accelerates after tank hits bottom. yes ___ no ___
4. Decelerates on top of rear lip of ditch. yes ___ no ___
5. Hits ground without bouncing. yes ___ no ___
6. Time from "Begin" signal: _____ seconds ___ ___

Score is number of "yes" column checks. Total: ____________

Remarks:
Scorer:

Slalom

Instructions for Scorers

1. There will be two scorers for the exercise.
2. Each scorer will have a hand signal flag (day) or a flashlight (night), pencils, and five copies of his Score Sheet. In addition, scorer #2 will have a stopwatch.
3. The tanks will be halted by scorer #1 at a previously marked position 25 yards from the first marker.
4. Scorer #1 will mount the first tank and say to the tank commander: "Your tank will move through this course as fast as possible, passing to the right of the first marker, to the left of the second one, and so on, zigzaging until you have passed all of the markers. Go as fast as you can, but don't hit any of the markers. I will move up to the starting line now. When you see me raise the flag (flashlight, if at night), move out. After you pass the last marker, proceed according to your instructions. Remember--as fast as you can, without hitting a marker."
5. Scorer #1 will then move to the previously marked starting line, and position himself so that he can easily see when the tank passes the starting line.
6. Scorer #2 will stand near the sixth marker in such a position that he can easily see the flag (or flashlight) held by Scorer #1, and raise his flag (or flashlight) above his head to signal that he is ready.
7. When Scorer #1 sees that Scorer #2 is ready, he will raise the signal flag (or flashlight, at night) above his head, and the tank will move toward the starting line.
8. As soon as the tank reaches the starting line, Scorer #1 will bring down the signal flag (or flashlight), and will move with the tank past the first five markers, marking with a check (√) the blank under either "Hit" or "Missed" on the score sheet, as appropriate, for each of the first five markers.
9. As soon as the tank has passed the fifth marker, Scorer #1 will return to the position where the other tanks are parked, mount the next tank, and wait for the signal that Scorer #2 is ready again.
10. As soon as Scorer #1 lowers the signal flag (or flashlight), Scorer #2 will start the stopwatch and lower his flag (or flashlight).
11. Scorer #2 will move with the tank past the last five markers, marking the score sheet appropriately, as for Scorer #1.
12. As soon as the tank reaches the previously marked finish line, Scorer #2 will stop the watch and record the time to the nearest second in the blank space in item #2, "Time:____seconds" on the Score Sheet.
13. Scorer #2 will then return to his original position near the sixth marker, reset his watch at "0", and signal Scorer #1 that he is ready by raising his flag (or flashlight).
14. The above procedure will be followed until all five tanks have completed the exercise.
15. If a tank fails to pass a marker (or markers) on the correct side, that/those marker/s will be shown as "Hit" on the Score Sheet, and the information will be recorded in the "Remarks" section.
16. Tank will use IR at night.

SCORE SHEET: Slalom, Scorer #1

Date:________ Group No:_______ Crew No.: ________ Time: _______

Marker #	Hit	Missed
1	___	______
2	___	______
3	___	______
4	___	______
5	___	______

Remarks:
Scorer: ________________

SCORE SHEET: Slalom, Scorer #2

Date: _______ Group No.: _______ Crew No.: ________ Time: _______

Marker #	Hit	Missed
6	___	______
7	___	______
8	___	______
9	___	______
10	___	______

Time:______ seconds
Remarks:
Scorer: ________________

Mine Field

Instructions for Scorers

1. Four scorers, working in pairs, will be required.
2. All scorers will have pencils and score sheets, and one scorer in each pair will have a stopwatch. All scorers will have flashlights at night.
3. All scorers will be at a previously designated position 25 yards from the beginning of the minefield, at the start of the exercise, and will stop the tanks at that point.
4. The path through the minefield will be divided into ten parts, each separated from the others by a turn, numbered 1 through 10.
5. Two scorers will accompany each tank through the exercise, one on the right side, one on the left side.
6. The scorer on the left side of the first tank will mount the tank and tell the tank commander to move out toward the minefield, and will guide the tank, as necessary, to the minefield starting point.
7. When the tank reaches the starting point, the scorer will stop the tank and say to the tank commander, "When I say 'Move out' you will start through the minefield. Get through as fast as possible without hitting the marking tape on either side. When you have gone through the minefield, proceed according to your instructions. Remember, as fast as you can without touching the marking tapes."
8. The scorer will then dismount and say to the tank commander "Move out!" As soon as he says "Move out!" he will start the stopwatch.
9. Each scorer will move with the tank and will watch his side of the tank continuously for contact with the marking tape.
10. Scorers will make a mark (/) on the score sheet under "Hits" for the appropriate area each time that the tank touches the marking tape within that area.
11. As soon as the tank crosses the end of the minefield completely, the left-side scorer will stop the watch, order the tank to move on, record the time (to the nearest second) in the "Time" section of the score sheet, and reset the watch at "0."
12. Both scorers will return to the tanks at the initial position in front of the minefield.
13. As soon as the first tank has gone approximately half way through the minefield, the left-hand scorer at the second tank will order that tank to move out, and will proceed as above.
14. The above procedure will be followed until all tanks have completed the exercise.
15. No more than two tanks will be in the minefield at one time.
16. Tanks will use BOD, and scorers will use flashlights at night.

SCORE SHEET: Mine Field

Date: ________ Group No.: ________ Crew No.: ________ Time: ________

Left Side
Right Side (Cross out one)

Area	Hits
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Total ______________________________

Time: ______ seconds
Remarks:
Scorer: ______________________________

Annex 3: Surveillance Exercises

Passive Surveillance
Instructions for Target Controller

1. Target Controller will assign each target vehicle and personnel target to its initial location, using the appropriate Target Activation Sequence sheet provided by HumRRO personnel.
2. At least 15 minutes before the exercise is scheduled to begin, the Controller will assure that all target vehicles and personnel are in their designated target positions.
3. Controller will move to his position on the control tower and assure that all signals are functioning properly. He will have the appropriate Target Activation Sequence sheet, a stopwatch, pencils, and, at night, a flashlight.
4. Tanks will move into prepared positions, and one scorer will be assigned to each tank.
5. Controller will call each target in order to assure that each is ready to function.
6. Scorers will move into their assigned positions and signal Controller when they are ready.
7. When all of the scorer-ready lights on the Controller's panel are on, Controller will conduct the exercise as follows:
   a. Refer to "No. 1" on the Target Activation Sequence sheet in order to determine which target will appear first.
   b. Start the stopwatch.
   c. Command the first target to move out when the stopwatch reads four (4) minutes.
   d. Two minutes before the target is to move out, alert the target by radio.
   e. Thirty (30) seconds before the target is to move out, alert the target a second time.
   f. When it is time for the target to move into its exposed position, issue the command, "Move out."
   g. At the command "Move out," push the switch that turns off the scorer-ready lights and turns on the red lights on the scorer's panels. Stop, reset, and start the stopwatch.
   h. After exactly 45 seconds, operate the switch that turns off the lights on the scorers' panels, stop the stopwatch, and radio the target to return to its concealed position.
   i. Reset and start the stopwatch.
   j. Notify the previous target to move into its next concealed position, if appropriate.
   k. Mark the blank space under "Activate" at the end of the first row with an "X" to indicate that this target has been used.
   l. Command the next target to move out when the stopwatch reads seven (7) minutes, repeating steps "d" through "k".
   m. Proceed as above for the remaining targets, waiting seven (7) minutes after each odd-numbered target, and four (4) minutes after each even-numbered target.
8. Procedure at night will be the same as that for day, except that Controller will use a flashlight when reading and marking the Target Activation Sequence sheets, only, shielding the flashlight during use so that the light is not visible to the tank crews.

Passive Surveillance
Instructions for Scorers

1. Tanks will move into prepared positions. There will be five (5) scorers, each assigned to one tank, and each assigned a number from 1 through 5.
2. Scorer will mount tank and assure that tank radio is turned off.
3. Scorer will make certain that his field telephone and the field telephone inside the turret are still connected and that both telephones operate properly. Scorer should report any malfunction IMMEDIATELY to the Target Controller.
4. Scorer will move into position assigned to him by HumRRO personnel. Scorer will have phone, stopwatch, instructions, Target Activation Sequence sheet, and score sheets. Scorers will fill in the blanks in the first two lines of the first score sheet with information from the Target Activation Sequence sheet.
5. Scorer will tell crew to report DIRECTION of target first, and IDENTIFICATION of target second.
6. Scorer will ignore the switch on his panel, never changing its initial position.
7. Scorer will man the phone.
8. As soon as a command to expose a target has been issued by the Target Controller, the red light on the scorer's position will come on.
9. As soon as the red light comes on, the scorer will start his watch. Scorer will know type of target, range, and direction, in each case, from data at the top of the score sheets, or from the Target Activation Sequence sheet.
10. The first crewman on the tank to detect the target will inform the scorer, via phone, as follows:
    Direction (e.g., "Right Front!")
    Identification (e.g., "Tank!")
11. As soon as the crewman reports Direction, IF DIRECTION IS CORRECT, scorer will record the time, to the nearest second, but will let the watch continue to run. Time will be recorded in the blank space in item #1 on the score sheet.
12. As soon as the crewman reports Identification, IF IDENTIFICATION IS CORRECT, scorer will stop the watch and record the time to the nearest second in the blank space in item #2 on the score sheet, and enter what the crewman has identified the target to be in the blank space in item #3 on the score sheet. He will then record the direction indicated by the crewman in the blank space in item #4 on the score sheet.
13. If the IDENTIFICATION REPORT IS INCORRECT, or if IDENTIFICATION IS NOT REPORTED, scorer will let the watch run. If the incorrect report is not corrected, or no report made, scorer will then stop the watch when the red light goes off, print "Identification incorrect" in the "Remarks" section of the Score Sheet, and fill in the blank space in item #2 as follows: "2. Time to identify: 45+ seconds."
    If the original incorrect report is corrected before the red light goes off, scorer will stop the watch and proceed as in item #12, and items #14-17.
14. Scorer will then ask the reporting crewman, via phone, "What was the target doing?" and check the appropriate blank space in item #5.
15. Scorer will then ask "What was the range?" and record this in the blank space in item #6.
16. Scorer will then ask "What is your crew position?" and record the answer in the blank space in item #7.

17. Scorer will then print his name in the blank space provided at the bottom of the Score Sheet, put the Score Sheet to one side, select the Score Sheet for the next target, and fill in the blanks in the first two lines of the Score Sheet with information from the Target Activation Sequence Sheet.

EXAMPLE

(IF CREWMAN IS CORRECT)

Crewman: "Right Front"
Scorer: a. Records time "1. Time to detect: 15 seconds."
b. Watch continues to run.

Crewman: "Tank:"
Scorer: a. Stops watch
b. Records time "2. Time to identify: 18 seconds."
c. Records report "3. Identification: Tank."
d. Records report "4. Direction to target: Right Front."
e. Asks "What was the target doing?"
f. Records report "5. Movement: None ___."
g. Asks "What was the range?"
h. Records report "6. Range: 1000 meters."
i. Asks "What is your crew position?"
j. Records report "7. Detected by: loader."
k. Prints name at bottom of score sheet.
l. Puts score sheet aside.
m. Selects score sheet for next target.
n. Pushes signal switch.

18. If the first report of Direction by a crewman is INCORRECT, scorer will assume that crewman has not seen the target, but will record the time as in item #9, above, and let the watch continue to run. If Identification is correct, scorer will assume that the crewman saw the target (even though Direction was reported incorrectly), will stop the watch, and record responses as in items 10-16, above. Scorer will then print "Direction incorrect" in the "Remarks" section of the score sheet.
19. If the first report of Direction is INCORRECT, but is corrected before the Identification report is given, scorer will proceed as in items 10-16, above. Any change of an incorrect Direction report after the Identification report has been given will be ignored, and "Direction incorrect" will be recorded in the "Remarks" section of the score sheet.
20. If two or more crewmen report at the same time, scorer will accept the report which is correct as though it were the only report given.
21. Procedure at night will be the same as that for day, above, except that scorers will use flashlights when filling in the score sheets, only, shielding the flashlight during use so that light is not visible to the tank crews.
22. At completion, scorers will instruct the crew to turn their tank radios on, remove the field telephone from the tank, and assure that all equipment is put away.

Passive Surveillance
Instructions for Target Personnel

1. Prior to the exercise, all target personnel must know the locations of their concealed and exposed positions, so that they can move quickly, day and night. Personnel with two positions must know the route between the positions.
2. Target personnel will be informed by the Target Controller which position will be the initial position.
3. Target personnel and vehicles will move to the first concealed positions at least fifteen (15) minutes before the exercise is to begin.
4. All concealed positions will be such that vehicles and personnel will not be visible to crewmen on the tanks at the exercise observation point.
5. For each concealed position there will be an exposure position, of such nature that it is visible from all tanks at the exercise position.
6. Personnel will communicate with the Target Controller by radio.
7. Two minutes before a target vehicle or target group is to move from its concealed position to its exposed position, the Target Controller will issue an alert by radio.

Passive Surveillance
Target Activation Sequence
Day I

No.	Target	Range	Direction	Activate
1	I-4 (Troops)	275	Right	
2	T-2 (Tank)	610	Center	
3	T-4 (Tank)	600	Right	
4	J-3 (Jeep)	440	Center	
5	I-1 (Troops)	496	Left	
6	J-2 (Jeep)	496	Left	
7	I-3 (Troops)	590	Center	
8	T-3 (Tank)	1010	Right	
9	J-1 (Jeep)	450	Left	
10	J-4 (Jeep)	590	Rt. Center	
11	T-1 (Tank)	540	Left	
12	I-2 (Troops)	220	Center	

Passive Surveillance
Target Activation Sequence
Night I

No.	Target	Range	Direction	Activate
1	T-2 (Tank)	610	Center	
2	J-4 (Jeep)	590	Rt. Center	
3	T-4 (Tank)	600	Right	
4	T-1 (Tank)	540	Left	
5	J-3 (Jeep)	440	Center	
6	I-2 (Troops)	220	Center	
7	I-4 (Troops)	275	Right	
8	T-3 (Tank)	1010	Right	
9	I-3 (Troops)	590	Center	
10	J-1 (Jeep)	450	Left	
11	I-1 (Troops)	496	Left	
12	J-2 (Jeep)	496	Left	

Passive Surveillance
Target Activation Sequence
Day II

No.	Target	Range	Direction	Activate
1	T-3 (Tank)	1010	Right	
2	J-3 (Jeep)	440	Center	
3	I-3 (Troops)	590	Center	
4	T-1 (Tank)	540	Left	
5	I-1 (Troops)	496	Left	
6	J-1 (Jeep)	450	Left	
7	T-4 (Tank)	600	Right	
8	I-4 (Troops)	275	Right	
9	T-2 (Tank)	610	Center	
10	J-4 (Jeep)	590	Rt. Center	
11	J-2 (Jeep)	496	Left	
12	I-2 (Troops)	220	Center	

Passive Surveillance
Target Activation Sequence
Night II

No.	Target	Range	Direction	Activate
1	J-3 (Jeep)	440	Center	
2	I-1 (Troops)	496	Left	
3	T-1 (Tank)	540	Left	
4	J-2 (Jeep)	496	Left	
5	T-4 (Tank)	600	Right	
6	I-4 (Troops)	275	Right	
7	J-4 (Jeep)	590	Rt. Center	
8	T-3 (Tank)	1010	Right	
9	J-1 (Jeep)	450	Left	
10	I-3 (Troops)	590	Center	
11	T-2 (Tank)	610	Center	
12	I-2 (Troops)	220	Center	

SCORE SHEET

Passive Surveillance

Date: __________ Group No.: __________ Crew No.: __________ Time: __________
Target: __________ Range: __________ Movement: __________ Weather: __________

1. Time to detect: ______ seconds
2. Time to identify: ______ seconds
3. Identification: ______________
4. Direction to target: ______________
5. Movement: None _____ Right _____ Left _____ Toward _______
   Away from ________
6. Range: ______________
7. Detected by: ______________

Remarks:
Scorer: ______________

Moving Surveillance

Instructions for Scorers—General

1. Three scorers will be required at each of the two target positions, for each exercise. One man, the Telephone Operator, will be designated to watch for tanks and operate the TA-1 telephone. A second man, the MG scorer, will fire the machine gun. A third man, the Data Recorder, will operate the stopwatch and score the exercise.
2. Scorers will be at target positions at least thirty (30) minutes prior to arrival at the targets of the first tank.
3. Upon arrival at target positions, scorers will set up the M60 MG and assure that it is functioning properly by firing 25-50 rounds of blank ammunition. If MG is found to function improperly, it will be replaced with the spare MG provided for that purpose.
4. When it has been determined that the MG is functioning properly, the Telephone Operator will move into his predetermined position. Upon his arrival at the position, he will assure that the telephone is operating properly by telephoning the Data Recorder. If the telephone does not function properly, it will be replaced.
5. When all equipment is functioning properly, the Data Recorder will fill in, with pencil, the blanks in the first line of the score sheet, with information provided by HumRRO personnel. The MG scorer will man the MG, and the Telephone Operator will remain in his designated position, watching for tanks.

Moving Surveillance
Instructions for Scorer–Telephone Operator

1. When the Platoon Leader's command vehicle passes the Telephone Operator's position, the Telephone Operator will alert the Data Recorder using the telephone.
2. After the command vehicle has passed, the Telephone Operator will watch for the first tank while maintaining telephone contact with the Data Recorder.
3. As soon as the first tank is directly in front of his position, the Telephone Operator will immediately inform the Data Recorder over the telephone by saying "FIRE!"
4. After the first tank passes, the Telephone Operator will continue to watch for the remaining four (4) tanks, informing the Data Recorder as each one passes by saying, "FIRE!"

Moving Surveillance
Instructions for Scorer–MG
Day

1. When the Data Recorder announces that the command vehicle has passed, the MG scorer will remain alert.
2. As soon as the Data Recorder says "FIRE!" the MG scorer will commence firing at the tank.
3. MG scorer will fire in continuous bursts of 100 rounds.
4. While firing, the MG scorer will also observe whether or not the main gun is pointed at the target position at any time while the coaxial MG is firing.
5. After 100 rounds have been fired, the MG scorer will reload the MG, in preparation for the next tank, and report to the Data Recorder his estimate of the accuracy of the coaxial MG fire.
6. The above procedures will be followed until all remaining tanks have completed the exercise.
7. Scorers will be transported to the Base Camp.

Night

All procedures will be the same as for "Day," above, except accuracy estimates, and the firing of the coaxial MG. Accuracy will be estimated at night by observing the tank searchlight beam. If the searchlight is on the target position at any time, credit will be given for hits. The scoring time will start when the command "FIRE!" is received and will end when the searchlight is turned on.

Moving Surveillance
Instructions for Scorer–Data Recorder
Day

1. When alerted by the Telephone Operator that the command vehicle has passed, Data Recorder will alert the MG Scorer and will remain in constant telephone contact with the Telephone Operator.
2. As soon as the Telephone Operator says "FIRE!" the Data Recorder will say to the MG scorer, "FIRE!" and will start his stopwatch.
3. As soon as the tank begins to fire its coaxial MG at the target, the Data Recorder will stop his stopwatch.
4. At all times while the tank is firing, the Data Recorder will observe the lay of the main gun, and will decide from the lay of the gun whether or not the coaxial MG was pointed at the target position at any time while it was firing.
5. As soon as the first tank has ceased firing, the Data Recorder will read the stopwatch and record the time to the nearest second in the blank space in item #1 on the score sheet (e.g., "1. Time to take under fire: 3 seconds").
6. As soon as he has recorded the time, the Data Recorder will reset his stopwatch.
7. After resetting his stopwatch, the Data Recorder will make a check mark (√) in the blank space after "Hit" if he has observed the tank's coaxial MG pointed at the target position during firing ("2. Accuracy: Hit √ Miss __"). If he has observed that the coaxial MG was not pointed at the target position at any time during firing, the Data Recorder will mark the blank space after "Miss" ("2. Accuracy: Hit__ Miss √ ").
8. If any scorer observes events which he thinks may be of importance for the exercise, during the "run" of the tank, these should be recorded, briefly, under "Remarks:" on the score sheet for that tank.
9. The above steps will be repeated for each of the remaining four tanks.
10. When all five tanks have passed through the exercise, the Data Recorder will print his name at the bottom of each score sheet in the space labeled "Scorer," and hand the score sheets to the designated officer.
11. Scorers will be transported to Base Camp, or to another exercise, as required.

Night

All procedures will be the same as for "Day," above, except accuracy estimates and the firing of the coaxial MG. Accuracy will be estimated at night by observing the tank searchlight beam. If the searchlight is on the target position at any time, credit will be given for hits. The scoring time will start when the command "FIRE!" is received and will end when the searchlight is turned on.

SCORE SHEET

Moving Surveillance

Date:__________ Group No.:__________ Crew No.:__________ Time:__________
Target No.:__________

1. Time to take under fire:__________ seconds
2. Accuracy: Hit______ Miss______
   Remarks:
   Scorer:__________

Annex 4: Gunnery Exercises

Procedure

1. GENERAL.

a. The gunnery exercises will be conducted in three (3) phases. Each phase will consist of DAY and NIGHT firing. The firing of the three phases will be identical whether fired during DAYLIGHT or DARKNESS; except that NIGHT firing will be aided by use of the tank-mounted searchlight, and flares provided by a 4.2 Mortar Squad.

b. The three phases will be fired in the following sequence:

(1) Phase I--Firing the main gun at stationary targets.
(2) Phase III--Firing the main gun and the caliber .50 machine gun at moving targets.
(3) Phase II--Firing the coaxial machine gun from a moving tank at stationary area-size targets.

c. Phases I and II will each be conducted on a stationary target range. Phase III will be conducted on a moving target range.

2. BORESIGHTING AND ZEROING.

a. Boresighting. All tank-mounted weapons will be boresighted at the Phase I firing range, prior to the exercise.

b. Zeroing. All tank-mounted weapons will be zeroed. These weapons will be zeroed on the same targets available for boresighting. If a tank crew is unable to zero a weapon, the OIC will take appropriate action to ensure that the weapon is zeroed before the exercise begins.

(1) Main gun. Three 12' x 12' panel targets will be located at 1200 meters for this purpose. (See sketch No. 1--Target Arrangement).
(2) Coaxial machine gun. Five type-E panel targets will be located at 300 meters for this purpose. (See sketch No. 1--Target Arrangement).
(3) Caliber .50 machine gun. Three 12' x 12' panel targets will be located at 800 meters for this purpose. (See sketch No. 1--Target Arrangement).

c. Scorer Responsibility. Firing a weapon for the purpose of ZEROING will not start until the OIC issues the order to each scorer individually. The scorer will report to the OIC when zeroing is satisfactorily completed. All subsequent firing will be on order from OIC only, to the tank commander.

3. SUBSEQUENT ZEROING PROCEDURE.

Each time tanks arrive at their firing positions on PHASE I each weapon will be fired, on order of the OIC, at their ZEROING target for verification of the established zero. Refinement of the zero will be made, if necessary.

4. MORTAR SQUAD SUPPORT (FLARES).

The Mortar Squad must determine their firing position, and register their weapon, prior to the start of Phase I. The squad must be prepared to place flares between the near set of targets (700-900 meters) and the middle set of targets (1100-1300 meters) during Phase I.

5. SEARCHLIGHT.

Tank searchlights will be used at night to illuminate all zeroing targets, the far targets for Phase I (1500-1700 meters), and all targets used in Phases II and III.

Phase I

1. GENERAL.

a. Tank Firing Positions. Five tanks will be on the firing line simultaneously. Each tank will be assigned a firing position by the OIC PRIOR to arrival of the Experimental or Control Groups. Only 3 tanks will be fired at any one time.

b. Loading of Ammunition into Tanks. The OIC will cause each tank to be loaded with the number of rounds required to checkfire the main gun and fire Phase I of the exercise, plus sufficient Cal. .50 and 7.62mm rounds to checkfire the caliber .50 and coaxial machine guns.

c. Briefings and Instructions. All crew members will be given a briefing on the conduct of PHASE I, and instructions on Army and local range firing precautions. Crews will then be assigned to the firing tanks which are already on line. Crews will complete their firing, and return to their own tanks, to complete their RTP exercise.

d. Completion of Phase I Firing. As each tank's firing is completed, the OIC will cause weapons to be cleared, and a report to that effect made by the tank commander. Then all 105mm ammunition will be off-loaded and returned to the stockpile.

2. TARGET ARRANGEMENT (See Figure A-1)

a. Target Sets. Three target SETS will be pre-positioned in the target area. Each target SET consists of three 6′ x 6′ panel targets. Each tank will be assigned to fire at a SET of targets, with the main gun.

(1) Ranges to the targets. Within each SET, one target will be positioned from 700 to 900 meters; one from 1100-1300 meters; and one 1500 to 1700 meters.

(2) Alternate target positions. Within each SET, each of the targets will have 3 previously prepared positions WITHIN EACH TARGET'S RANGE, i.e., the target in the 700 to 900 meter range will have 3 positions in which it can be placed--at 700, 800, and 900 meters. The same provisions will be available for each target in each SET.

(3) Lateral distance between targets. Lateral distance between targets in each SET must not be less than 25 meters.

(4) Lateral distance between SETS. Lateral distance between each SET must not be less than 75 meters, measured from the center of one SET to the center of adjacent SETS.

b. Boresighting and Zeroing Targets.

(1) Main gun. Three 12′ x 12′ panel targets will be located with each SET of targets at 1200 meters.

(2) Coaxial machine gun. Five type-E targets will be located forward of each SET of targets at 300 meters.

(3) Caliber .50 machine gun. Three 12′ x 12′ panel targets will be located to the right of each SET of targets at 800 meters.

c. Subsequent Use of Boresight and Zeroing Targets. All targets will remain in position for subsequent zero check firings, and if necessary, refinement of the established zero.

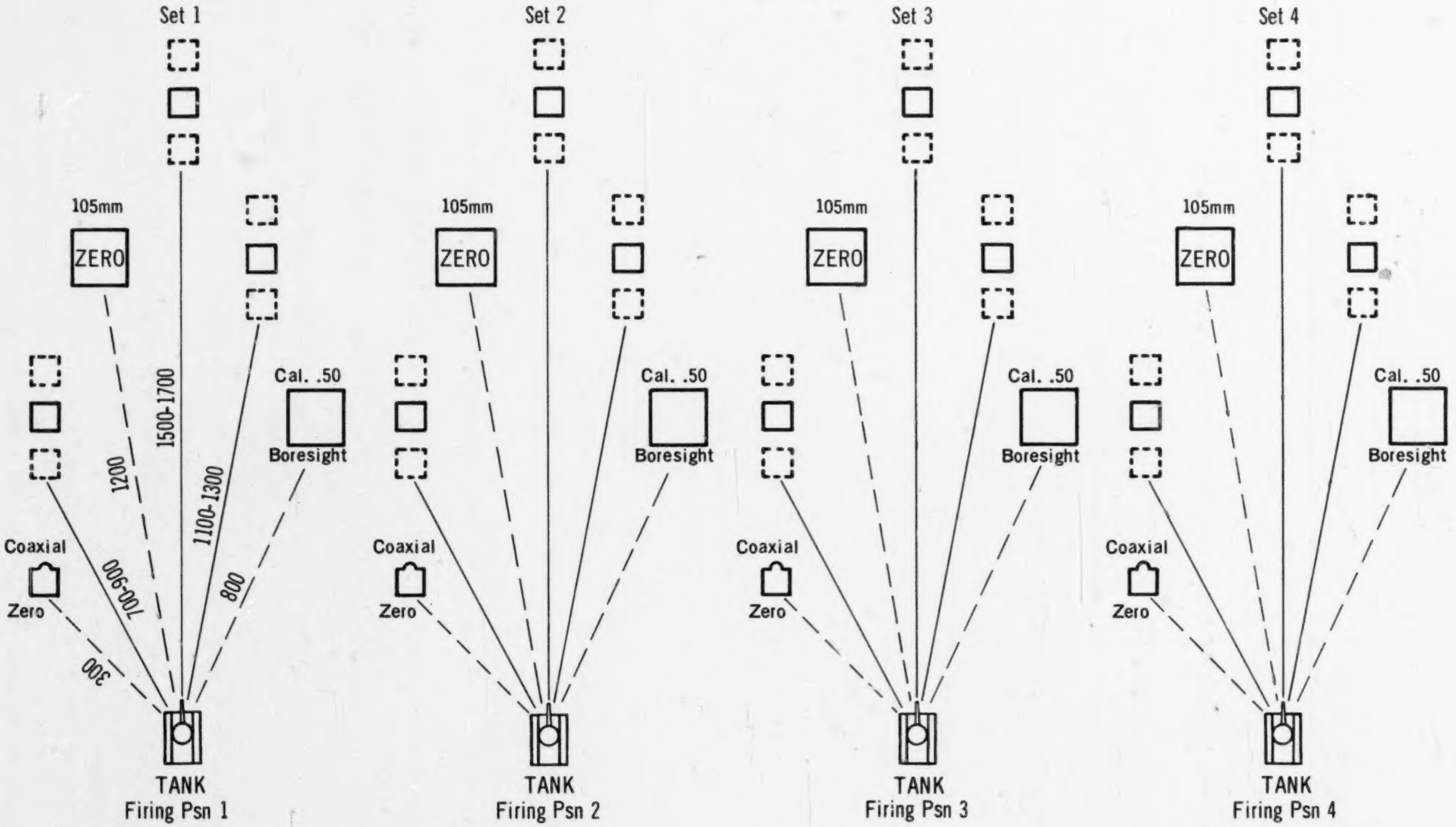
d. Target Replacement. Upon completion of each exercise on PHASE I, all targets with one or more hits will be replaced prior to the next exercise.

3. PROCEDURE.

a. Arrival at Firing Range. Tanks will take tactical positions BEHIND the firing position areas. Crews will be assembled. The OIC will brief the crews on PHASE I, and issue instructions reference safety precautions.

b. Assignment of Firing Positions and Target Sets. The OIC will assign firing tanks to each crew. (A record of this assignment will be maintained to ensure that the same firing position will not be assigned to the same crew on subsequent PHASE I exercises). The crews will move to their assigned tanks on order of the OIC.

Target Positions for Gunnery Exercises: Phase 1


Set 1
Set 2
Set 3
Set 4
105mm
ZERO
Cal. .50
Boresight
Coaxial
Zero
1500-1700
1200
1100-1300
700-900
800
300
TANK
Firing Psn 1
TANK
Firing Psn 2
TANK
Firing Psn 3
TANK
Firing Psn 4

* This sketch shows 4 positions–there were 5 Positions.

⬚ Alternate Target Positions. Targets were repositioned after each exercise.

Figure A-1

c. Loading of Ammunition into Tanks. The five firing tanks already on line, will be previously loaded by ammo detail to accommodate the tank crews.

d. Zeroing. The OIC will order each crew to fire zero check rounds. No crew will begin until the OIC gives the specific order.

(1) Main gun. The scorer will inform the OIC when zero is correct.

(2) Caliber .50 machine gun. The scorer will inform the OIC when zero is correct.

(3) Coaxial machine gun. The scorer will report to the OIC when zero is correct.

e. Subsequent Zero Checks, Upon subsequent arrivals on the PHASE I firing range, the OIC will issue orders to each tank commander to fire a check round for zero verification, and refinement of the established zero, if deemed necessary, for all tank-mounted weapons.

(1) Daylight check. Upon orders from the OIC, each tank commander will cause the zero of the main gun to be checked. Tank commander will report the results of the check to the OIC. The OIC will order a refinement, if tank commander so recommends. Tank commander will report the completion of the refinement to the OIC, and await further orders. This same procedure will be followed in turn for the Caliber .50 machine gun, then the coaxial machine gun.

(2) Night check. Same procedure as for daylight, except that the OIC will be responsible for coordinating searchlight illumination over the target area with the firing of check rounds.

f. Firing Procedure. When all weapons have been boresighted, and zeroed, all crews will stand-by awaiting their orders to take their targets under fire with the main gun. The OIC will issue orders to fire to each tank commander designating the specific target, within each crew's target SET, he wants the crew to take under fire (i.e., Near, Medium, or Far range). Each crew may fire only 3 rounds at the target designated. If a "hit" is recorded on the first or second shot, firing will cease. The tank commander reports to the OIC that firing on the target is completed, and awaits the OIC's next order to fire. TANK COMMANDERS WILL NOT SHIFT TO ANOTHER TARGET UNTIL RECEIVING A SPECIFIC ORDER FROM THE OIC TO DO SO. When the 3 targets in the SET have been engaged, and firing is completed, each tank commander will cause the main gun to be cleared, and will immediately report the weapon "cleared" to the OIC. All tanks will remain in position until ordered to move to the PHASE III firing range.

(1) Daylight procedure. Same as above, whether it be the initial or a subsequent PHASE I exercise.

(2) Night procedure. Same as for daylight except that the OIC is responsible for placing flares between the near targets (700-900 meters) and the middle targets (1100-1300 meters), and for illuminating the far targets (1500-1700 meters) by searchlight.

g. Off-loading Unexpended Ammunition. When Phase I firing is completed, and all guns (main gun; caliber .50; and coaxial machine gun) have been reported "cleared" to the OIC, the OIC will cause all unexpended 105mm ammunition, Cal. .50 ammunition, and 7.62mm ammunition to be off-loaded by the tank crews, and returned to the ammunition stock pile by the ammunition detail.

4. SCORING.

Scoring will include firing accuracy (hit on target), and reaction time (time elapsed between the order to fire and the actual firing). These two scoring items will be scored for each target in each SET. (Daylight and Night firing).

a. Determining a Target Hit. Two scorers will be assigned to each tank on the firing line. One scorer, equipped with a BC scope, will make observations of each target. In the event of a disagreement between scorers, accuracy will be determined by inspection of the target after all firing has ceased. (Should disagreement occur after the first or second rounds, the crew will continue firing until 3 rounds have been fired). Hits will be recorded on the score sheet.

b. Determining Reaction Time. One scorer will be equipped with a stopwatch. Timing will begin when the tank commander "Rogers" the OIC's order to fire on a target. Timing will stop when the first round (at each target is fired. Elapsed time will be recorded on the score sheet.

(END OF PHASE I)

Phase II

1. GENERAL.

a. Upon completing PHASE III, the OIC will order the firing tanks to move to the PHASE II firng range.

b. All tanks will be assigned positions behind the firing line.

c. The OIC will brief the tank crews on the PHASE II firing procedure and review range safety precautions.

d. PHASE II consists of firing the coaxial machine gun at a stationary area target (6' x 15') from a moving tank.

e. Scoring will be for firing accuracy (hits) only.

f. Each tank will make one run per exercise.

g. Each tank will engage 3 targets; one at 200 meters, one at 300 meters, and one at 400 meters.

h. One burst of 20 rounds will be fired at each target.

i. Ammunition belts will be loaded with 60 rounds, with an empty loop behind the 20th, 40th, and 60th round, to ensure that only 20 rounds will be fired at each target.

j. Sketch No. 2--target arrangement and procedure for PHASE II.

2. TARGET ARRANGEMENT. (See Figure A-2)

a. There are 3 groups of targets--Group "A", Group "B", and Group "C". Each group of targets is located at a different range--200, 300, and 400 meters. Each group consists of 5 targets. Each target, within each group, is numbered 1 thru 5.

b. No Group of targets will ever be placed at the same range as another Group. All 5 targets of a Group will always be positioned at the same range.

c. Two alternate target positions are provided for each target in each Group.

d. Distance Between Targets within Each Group. Targets will be positioned 50 feet apart.

e. Distance Between Groups of Targets. Groups of targets will be not less than 50 meters apart.

f. Green Warning Flags. Green flags indicate the start of a firing run.

g. Red Warning Flags. Red flags indicate cease-fire line.

h. Use of Alternate Target Positions. The initial run will have the targets positioned as shown in Figure A-2 (the Solid target outlines). When the first exercise is completed (five tanks participating--each tank will have fired at a different target in each Group of targets) the targets will be scored, and then each Group of targets will be shifted to an alternate position--assuring that no Group of targets is located at the same range as another Group. This makes the course ready for the next PHASE II exercise. This procedure will be followed upon completion of each exercise.

i. Target Numbers. Targets will NOT be positioned with target numbers in sequence, i.e., 1, 2, 3, 4, 5, or 5, 4, 3, 2, 1. The positions shown in Figure A-2 are suggested.

j. Target Replacement. Individual targets (same identity number) will be replaced as deemed necessary by the scorers.

Target and Tank Positions for Gunnery Exercises: Phase II

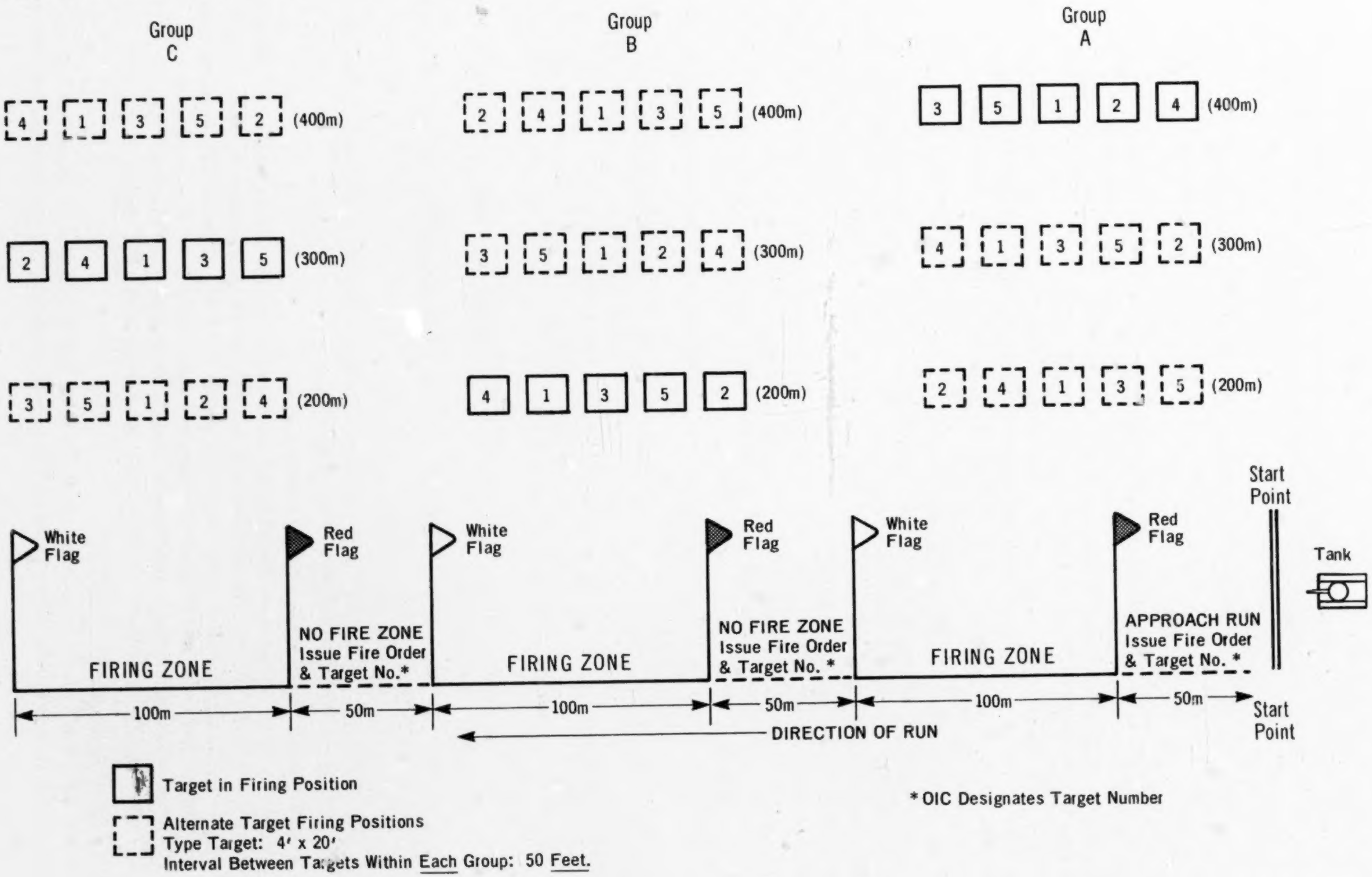

Group C
4
1
3
5
2
(400m)
2
4
1
3
5
(300m)
3
5
1
2
4
(200m)
Group B
2
4
1
3
5
(400m)
3
5
1
2
4
(300m)
4
1
3
5
2
(200m)
Group A
3
5
1
2
4
(400m)
4
1
3
5
2
(300m)
2
4
1
3
5
(200m)
White Flag
Red Flag
White Flag
Red Flag
White Flag
Red Flag
Start Point
Tank
FIRING ZONE
NO FIRE ZONE Issue Fire Order & Target No.*
FIRING ZONE
NO FIRE ZONE Issue Fire Order & Target No. *
FIRING ZONE
APPROACH RUN Issue Fire Order & Target No. *
100m
50m
100m
50m
100m
50m
Start Point
DIRECTION OF RUN
Target in Firing Position
Alternate Target Firing Positions
Type Target: 4' x 20'
Interval Between Targets Within Each Group: 50 Feet.
* OIC Designates Target Number

Figure A-2

3. FIRING PROCEDURE.

After the crews have been briefed, and instructed on safety precautions, the OIC will order one crew to position their tank behind the START POINT (See Figure A-2). Remainder of tanks (4) will occupy their tactical positions until the OIC orders one of them to the START POINT.

a. Starting the Exercise. The tank is halted behind the START POINT. The coaxial machine gun will be pointed down range. The tank commander will report his readiness to start to the OIC.

b. The OIC Instructions to the Tank Commander. The OIC will give the command to move out at 7-10 mph, and to maintain this speed through the entire exercise. When the tank has crossed the START POINT, the OIC will give the tank commander the order to fire and the NUMBER of the target to be taken under fire.

c. Tank Commander's Actions. The tank commander "Rogers" the OIC's order, orders the coaxial machine gun to be fully loaded, and issues his fire command. Firing may start as soon as the tank passes the GREEN flag. Only one burst of 20 rounds will be fired at the designated target.

d. Cease Fire. In all cases, firing will cease when the tank reaches the RED flag.

e. Subsequent Orders and Firing. (Because of the empty loop in the ammunition belt, only 20 rounds can be fired without reloading). As the tank moves into the NO FIRE ZONE (after firing the first designated target) the OIC will designate the next target to be taken under fire, by NUMBER.

(1) Tank Commander. The tank commander "ROGERS" the OIC's order. Orders the coaxial to be full-loaded. Issues the fire command.

(2) Firing. The designated target is fired on at any time after the tank passes the GREEN flag.

(3) Cease firing. Firing ceases when 20 rounds have been expended, or when the tank reaches the RED flag.

f. Completion of the Exercise. The above procedure will be adhered to for the 3rd and final target. The tank will be halted after passing the 3rd RED flag. The coaxial MG will be cleared, and certified CLEAR by the tank commander, to the OIC.

(1) The OIC. The OIC will order the tank back to its original tactical position, then order the next tank to the START POINT, and follow the procedure outlined above.

(2) Exercise continuance. This procedure will be followed until all 5 tanks have completed the exercise.

g. Precaution. The OIC must ensure that no target is designated to be fired upon more than once during each exercise.

h. Daylight Exercise. Same as preceding outline.

i. Night Exercise. Same as preceding outline, except the OIC is responsible for maintaining searchlight illumination over the target area.

4. SCORING AND SHIFTING OF TARGETS.

a. Scoring. After completion of firing on each target, scorer will estimate, by observation of tracers, the hits on the targets, and record on the score sheet for that target "Excellent", if it appears that more than 15 rounds have hit, "Good" if it appears that 5 to 15 rounds have hit, and "Poor" if it appears that fewer than 5 rounds have hit.

b. Shifting of Targets. When the targets have been scored for "hits", all targets will be shifted to different locations--one GROUP of 5 targets at each range.

5. OFF—LOADING AMMUNITION.

When a tank has cleared to coaxial machine gun, and is ordered to move back to its original position behind the firing line, the tank will proceed past the ammunition stockpile and off-load all 7.62mm ammunition and empty ammunition cases. It will then move to its original position.

(END OF PHASE II)

Phase III

1. GENERAL.

a. Upon Completion of Phase I, the five firing tanks will move to the Phase III firing range.

b. Phase III consists of firing the main gun and the caliber .50 machine gun from a stationary tank at a moving target.

c. The moving target will be fired upon at a FAR range with the main gun, only, and at a NEAR range with the caliber .50 machine gun, only.

d. Each tank will fire the main gun at the FAR range twice, and with the caliber .50 machine gun at the NEAR range twice.

e. Each tank will fire 3 rounds with the main gun at each of the two "passes" of the target at the far range, and 100 rounds of caliber .50 ammunition at each of the two "passes" of the target at the near range.

f. Scorers will record accuracy and reaction time.

g. Only one tank will be in firing position, on the firing line, at a time.

h. The exercise will be conducted in the same manner during DAY and NIGHT firing, except the OIC will order the target to be illuminated by searchlight during darkness.

2. AMMUNITION.

a. When each tank is ordered to the firing position, it will stop at the ammunition stock pile and load 6 rounds of main gun (105mm) ammunition.

b. Caliber .50 ammunition will be loaded 50 rounds per belt, and each tank will on-load two belts (100 rounds).

3. TARGET EXPOSURE AND DIRECTION OF MOVEMENT.

The FAR range (900 meters) will be used exclusively for the main gun. The direction of movement at the FAR range will be from left to right. The target will be fired upon (3 rounds) when it passes the left safety marker at the FAR range. As soon as it passes the right safety marker at the 900-meter range, firing with the main gun will cease, and the caliber .50 machine gun will be loaded. The NEAR range (600 meters) will be used exclusively for the caliber .50 machine gun. As soon as the target passes the right safety marker at the 600-meter range, moving from right to left, it will be fired upon with the caliber .50 machine gun. As soon as it passes the left safety marker, firing will cease.

4. EXERCISE PROCEDURE.

a. The OIC. The OIC will brief the crews on firing procedures and range safety precautions. Upon completion of the briefings, the OIC will order one crew to move their tank to the tank firing position on the firing line, stopping at the ammunition stock pile to load ammunition.

b. The Tank Commander. The tank commander will move his tank to the ammunition stock pile and supervise the stowing of the ammunition. He will then move his tank onto the firing position, and report to the OIC when his tank and crew are ready to fire.

c. The OIC. The OIC, in the meantime, will ascertain the position of the moving target and the preparedness of the scorers. Upon receiving the tank commander's report of "Ready on the firing line," and when the moving target is in proper position, the OIC will issue the order to fire, at the FAR range, with the main gun, first.

d. The Tank Commander. The tank commander will wait until the target clears the boundary safety marker, then issue his Fire Order.

e. Main Gun Firing Procedure. Three (3) rounds will be fired at the moving target during each "run." Firing will cease when:

(1) The target passes the opposite boundary safety marker, whether or not 3 rounds have been fired.

(2) The 3 rounds have been fired.

f. Caliber .50 Machine Gun Firing Procedure. As soon as the target has moved past the right safety marker at the FAR range, main gun firing will cease, and the caliber .50 machine gun will be loaded. As soon as the target has passed the right safety marker at the NEAR range, moving from right to left, 50 rounds will be fired at it. Firing will cease on each run when 50 rounds have been fired, or when the target passes the left safety marker, whichever occurs first.

g, Subsequent Target Runs. The procedure in paragraphs a through f, above, will be followed on subsequent runs, except that during NIGHT firing, the OIC will order the targets to be illuminated by searchlight.

h. Completion of Firing Exercise.

(1) The OIC. The OIC will order the tank commander to clear the guns and to report when the weapons are cleared. Upon receiving the TC's report that the weapons are clear, the OIC will order the TC to move to the ammunition stockpile and off-load all unexpended rounds and empty shell cases, then proceed to his original position behind the firing range.

(2) The Tank Commander. The TC will comply.

(3) The OIC. When the tank has left the ammunition stockpile, the OIC will order another crew onto the firing line. This procedure will continue until all crews have completed Phase III.

5. SCORING.

a. Scorers. Two scorers will be assigned to each tank on the firing line. One scorer will be positioned on the tank, while the other will be positioned adjacent to the tank with a BC scope.

b. Scoring the Main Gun Firing. Scoring will be based on accuracy of round selection and "hits" scored, and reaction time between issuance of the Fire Order and firing of the round.

(1) Accuracy of Round Selection. The scorer on the tank will observe the round selection, and record the selection on the score sheet.

(2) Hits. Hits will be counted by scorers observing through BC scopes or binoculars. "Hits" will be recorded as 1st round, 2nd round, and 3rd round "hits." Upon completion of firing Phase III, the scorer on the tank will score the "Round Selection Score" and "Round Hit Score."

(3) Time Reaction. The scorer on the tank, who is equipped with a stopwatch, will START the watch when the tank commander BEGINS giving his fire order, and will STOP the watch when the round is fired. The elapsed time will be recorded on the score sheet. The same procedure will be followed for SUBSEQUENT fire commands. Each "run" will provide 3 time reactions.

c. Scoring the Cal. .50 Machine Gun Firing. Scoring will be based on accuracy of fire (number of "hits") and reaction time between the target passing the right safety marker and the firing of the first round.

(1) Accuracy. The scorer positioned adjacent to the tank will assess "hits" by observation through a BC scope, or binoculars, and will evaluate the tank commander's "hits" performance as "NONE"--"FAIR"--"GOOD"--"EXCELLENT" (see score sheet for method of evaluation).

(2) Time Reaction. The scorer on the tank, equipped with a stopwatch, will START the watch when the target passes the right safety marker and STOP the watch when the first found is fired. The elapsed time will be recorded.

(END OF PHASE III)

PHASE I

SCORE SHEET

Gunnery

Date: __________ Group No.: __________ Crew No.: __________ Time: __________

1. Target #1
   a. Elapsed time to fire 1st round: _______ seconds
   b. 1st Round: Hit _____ Miss _____
   c. 2nd Round: Hit _____ Miss _____
   d. 3rd Round: Hit _____ Miss _____
2. Target #2
   a. Elapsed time to fire 1st round: _______ seconds
   b. 1st Round: Hit _____ Miss _____
   c. 2nd Round: Hit _____ Miss _____
   d. 3rd Round: Hit _____ Miss _____
3. Target #3
   a. Elapsed time to fire 1st round: _______ seconds
   b. 1st Round: Hit _____ Miss _____
   c. 2nd Round: Hit _____ Miss _____
   d. 3rd Round: Hit _____ Miss _____

PHASE II

SCORE SHEET

Gunnery

Date: __________ Group No.: __________ Crew No.: __________ Time: __________

1. Target #1
   a. Number of Hits: __________
2. Target #2
   a. Number of Hits: __________
3. Target #3
   a. Number of Hits: __________

PHASE III

SCORE SHEET

Gunnery

Date: ____________ Group No.: ______ Crew No.: ____________ Time: ____________

1. FAR TARGET (Main Gun) - First Run
   a. First Round. (Scorer starts timing when TC begins Fire Order)
      (1) Accuracy: Round HIT the target. Yes ____ No ____
      (2) Timing (Scorer stops watch when round is fired)
         (a) Elapsed time to fire FIRST round–seconds _________
   b. Second Round. (Scorer starts timing when TC begins Subsequent Order)
      (1) Accuracy: Round HIT the target. Yes ____ No ____
      (2) Timing (Scorer stops watch when round if fired)
         (a) Elapsed time to fire SECOND round–seconds _________
   c. Third Round. (Scorer starts timing when TC begins Subsequent Order)
      (1) Accuracy: Round HIT the target. Yes ____ No ____
      (2) Timing (Scorer stops watch when round is fired)
         (a) Elapsed time to fire THIRD round–seconds _________

2. NEAR TARGET (Caliber .50) - First Run
   a. Elapsed time to fire: _____ seconds
   b. Number of Hits: _____

Scoring Note:

"Hits" will be assessed as follows:

1. If it appears that 5 rounds or less have penetrated the target, the score will be NONE.
2. If it appears that 6 to 19 rounds have penetrated the target, the score will be FAIR.
3. If it appears that 20 to 29 rounds have penetrated the target, the score will be GOOD.
4. If it appears that 30 to 50 rounds have penetrated the target, the score will be EXCELLENT.

3. FAR TARGET (Main Gun) - Second Run
   a. First Round. (Scorer starts timing when TC begins Fire Order)
      (1) Accuracy: Round HIT the target. Yes ____ No ____
      (2) Timing (Scorer stops watch when round is fired)
         (a) Elapsed time to fire FIRST round–seconds _________
   b. Second Round. (Scorer starts timing when TC begins Subsequent Order)
      (1) Accuracy: Round HIT the target. Yes ____ No ____
      (2) Timing (Scorer stops watch when round is fired)
         (a) Elapsed time to fire SECOND round–seconds _________
   c. Third Round. (Scorer starts timing when TC begins Subsequent Order)
      (1) Accuracy: Round HIT the target. Yes ____ No ____
      (2) Timing (Scorer stops watch when round is fired)
         (a) Elapsed time to fire THIRD round–seconds _________

PHASE III (Continued)

4. NEAR TARGET (Caliber .50) - Second Run
   a. Elapsed time to fire: _____ seconds
   b. Number of Hits: _____

Scoring Note:
"Hits" will be assessed as follows:
1. If it appears that 5 rounds or less have penetrated the target, the score will be NONE.
2. If it appears that 6 to 19 rounds have penetrated the target, the score will be FAIR.
3. If it appears that 20 to 29 rounds have penetrated the target, the score will be GOOD.
4. If it appears that 30 to 50 rounds have penetrated the target, the score will be EXCELLENT.

Annex 5: Maintenance Exercise

Maintenance Exercise I

Instructions for Scorers

1. Tanks will be parked in prepared positions for the Passive Surveillance Exercise, and there will be one scorer for each tank.
2. Each scorer will have pencils, a stopwatch, and a score sheet.
3. Scorer will order the crew to dismount, and say: "When I say 'Begin' you will perform the usual During Operations services. Tank Commander, tell me as soon as you are finished. Begin!"
4. As soon as he says "Begin!" the scorer will start the watch.
5. The scorer will observe the activities of the crew, and will mark with a check (√) the blank after either "yes____" or "no____", depending upon whether or not the service was performed, after each of the seven (7) numbered items on the score sheet.
6. As soon as the Tank Commander says that the crew has finished, the scorer will stop the watch and record the time in the appropriate blank on the score sheet. No credit will be allowed for services performed after the watch has been stopped.
7. The scorer will then ask the crew to report any defects that they have found (low oil level, etc.), and will record any reported defects in the "Remarks" section of the score sheet. If none is reported, the scorer will write "No defects reported by crew" in the "Remarks" section.
8. The scorer will then check the tank for each item on the Score Sheet, and mark the score sheet as follows:
   a. If there is a check-mark in the "no" column for an item, put a "√"in the "0" column for that item.
   B If the scorer finds a defect for one of the items and no defect was reported, he will put a "√" in the "0" column for that item, even though the "yes" column has been checked.
   c. If the "yes" column has been checked and the scorer finds no defect for that item, he will put a "√" in the "1" column for that item.
   d. If the "yes" column has been checked and a defect has been reported for that item, the scorer will put a "√" in the "1" column for that item.
   e. If any member of the crew used a checklist, manual, etc., during the exercise, the scorer will record this information in the "Remarks" section of the score sheet (e.g., "Checklist used").
   f. The scorer will then print his name in the appropriate space at the bottom of the score sheet.
9. Scorer will assure that all defects are remedied at once. In the case of a defect which cannot be remedied at once, a replacement tank will be substituted for the tank with the defect.
10. Flashlights will be used by crew and scorer at night.

SCORE SHEET

Maintenance Exercise I

Date: ____________ Group No.: ____________ Crew No.: ____________ Time: ____________

1. Check engine oil level. yes ____ no ____ 0 ____ 1 ____
2. Check transmission oil level. yes ____ no ____ 0 ____ 1 ____
3. Check antennas. yes ____ no ____ 0 ____ 1 ____
4. Check battery water and cables. yes ____ no ____ 0 ____ 1 ____
5. Clean and inspect all vision devices. yes ____ no ____ 0 ____ 1 ____
6. Clean and inspect all exterior lights. yes ____ no ____ 0 ____ 1 ____
7. Check for fuel and lubricant leaks. yes ____ no ____ 0 ____ 1 ____

Total: ________

Score is number of "1" column checks.
Time: _____ seconds.

Remarks:
Checklist, manual, etc., used? yes____ no _____
Which? ____________
Scorer: ____________

Map of Experimental Test Site and Test Course

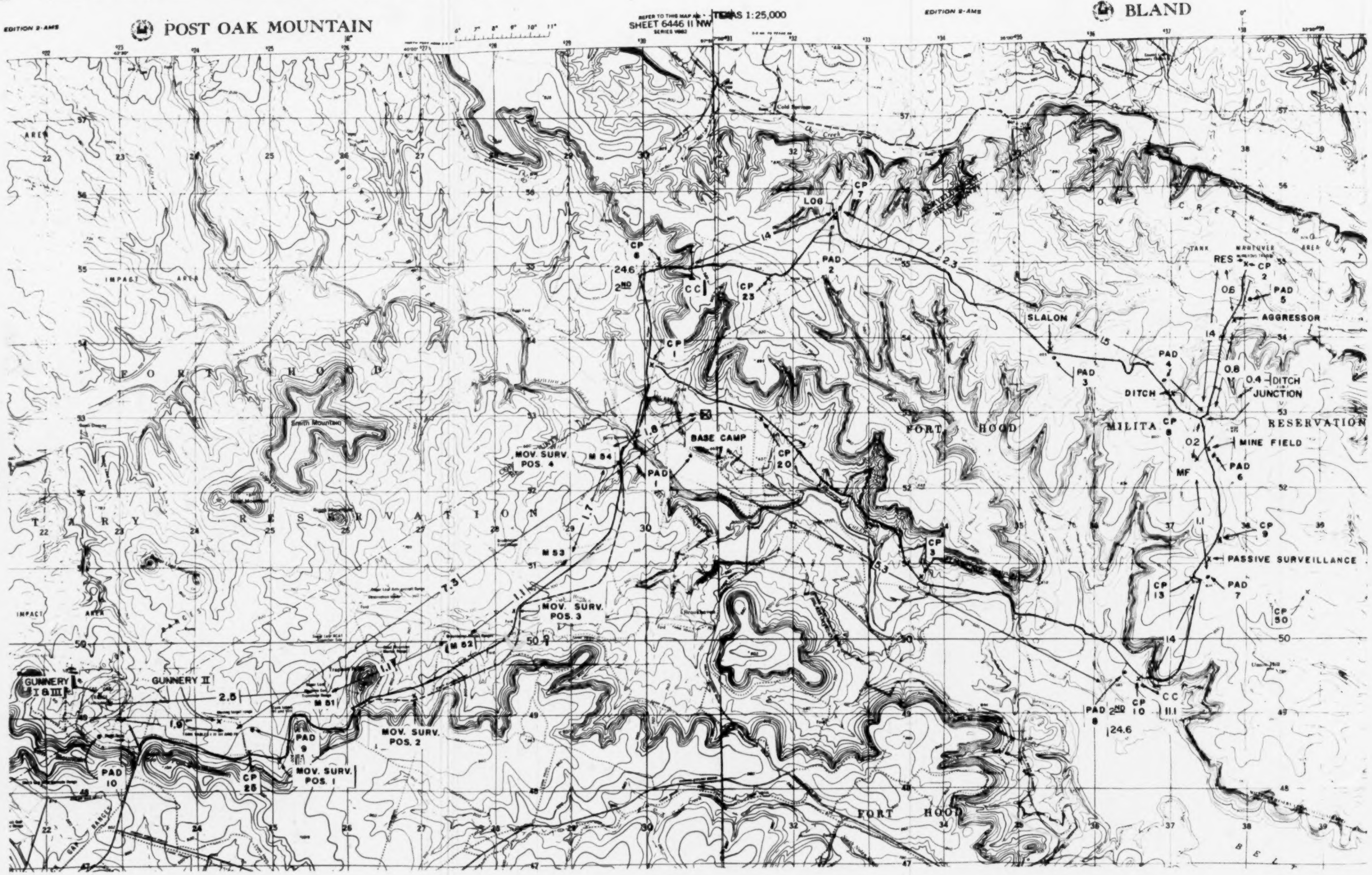

POST OAK MOUNTAIN
BLAND
SHEET 6446 II NW
TEXAS 1:25,000
EDITION 2-AMS
FORT HOOD
MILITARY RESERVATION
IMPACT AREA
OWL CREEK
LOG
CP 7
CP 6
24.6
2ND
CC
CP 23
PAD 2
23
14
SLALON
15
PAD 3
PAD 4
DITCH
RES
CP 2
0.6
PAD 5
AGGRESSOR
0.8
0.4
DITCH JUNCTION
CP 8
02
MINE FIELD
MF
PAD 6
CP 1
1.8
BASE CAMP
CP 20
PAD 1
M 54
MOV. SURV. POS. 4
1.7
M 53
7.3
1.1
MOV. SURV. POS. 3
50.9
M 52
CP 3
3.3
1.1
CP 9
PASSIVE SURVEILLANCE
CP 13
PAD 7
CP 50
14
CC
11.1
CP 10
PAD 8
2ND
24.6
GUNNERY I & III
GUNNERY II
2.5
1.9
M 51
PAD 9
MOV. SURV. POS. 2
MOV. SURV. POS. 1
CP 25
PAD 10
Smith Mountain

Figure A-3

Appendix B

SEQUENCE OF EVENTS
AND
OPERATIONS ORDERS

SEQUENCE OF EVENTS

The sequence of events for the experimental and control groups was the same, except for the rest period given to the control group. Sequence details are given below.

First Day

1. Subjects reported to Base Camp; noon meal
2. Administrative activities (assigned to quarters, etc.)
3. Briefings
    a. HumRRO
    b. Military
        (1) General
        (2) Oral Operations Order
        (3) Maps issued
4. Evening meal
5. Subjects to quarters. Lights out at 2200 hours

Succeeding Day/Days[1]

1. Reveille 0600 hours
2. Breakfast 0630 — 0700 hours
3. Administrative duties 0700 — 0730 hours
4. In assigned vehicles by 0735 hours
5. RTP 1 completed by 0800 hours
6. Fragmentary Order 1
7. Move out of Base Camp along trail
8. Fragmentary Order 2
9. Fragmentary Order 3
10. Log Obstacle 0820 hours
11. Slalom 0830 hours
12. Ditch 0840 hours
13. Fragmentary Order 4
14. Area reconnaissance
15. Fragmentary Order 5
16. Blank ammunition loaded; Fragmentary Order 6
17. Tanks move toward Checkpoint 15
18. Aggressor activity
19. Tanks move toward Checkpoints 8 and 9
20. Fragmentary Order 7
21. Minefield 0930 hours
22. Fragmentary Order 8
23. RTP 2
24. Maintenance I
25. Begin Passive Surveillance 1000 hours
26. Fragmentary Order 9
27. Aggressor activity
28. Fragmentary Order 10

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[1] Times are representative, since actual beginning times were never exactly the same.

29. Halt at Checkpoint 6
30. Moving Surveillance 1240 hours
31. Begin Gunnery Exercise 1300 hours
32. RTP 3
33. Fragmentary Order 11
34. Tanks move toward Checkpoint 25
35. Fragmentary Order 12
36. Moving Surveillance 1640 hours
37. Move to Base Camp
38. Maintenance II
39. RTP 4
40. Fragmentary Order 13
41. Tanks move out of Base Camp
42. Fragmentary Order 14
43. Obstacles (log, slalom, ditch) 1955 — 2030 hours
44. Fragmentary Order 15
45. Minefield 2040 hours
46. Fragmentary Order 16
47. RTP 5
48. Maintenance I
49. Begin Passive Surveillance 2120 hours
50. Fragmentary Order 17
51. Fragmentary Order 18
52. Moving Surveillance 0015 hours
53. Begin Gunnery Exercise 0100 hours
54. RTP 6
55. Fragmentary Order 19
56. Moving Surveillance 0535 hours
57. Tanks move to Base Camp
58. As above for subsequent days

OPERATIONS ORDER

Given to First Platoon, Company C

1. Situation
   a. Enemy Forces:
      1) Intelligence reports that elements of the 75th Mechanized Division are East of Belton Lake. They are moving West toward our present location.
   b. Friendly Forces:
      1) 2/50 Infantry is located along Grid Line 39.

2. Mission:
   1) The platoon will screen the area to the West of Grid Line 39. Screen will be in effect for 48 hours. The platoon is attached to the 2/50 Infantry because there is some indication of scattered armor resistance to the rear of the 2/50. We will screen this area to keep the 2/50 from getting cut off.

3. Execution:
   1) The platoon will initially be held in Reserve at Base Camp. Be ready to deploy on order.

4. Administration and Logistics:
   a. Breakfast 0630 hours, present assembly area.
   b. "C" rations will be issued with breakfast.
   c. Axis of evacuation: Recondo Road.
   d. Axis of supply: East Range Road.
   e. Medical support available at Base Camp.
   f. POL will be delivered as needed.
   g. Ammo supply points will be specified by company headquarters.

5. Signal and Command:
   a. Signal:
      Current SOI in effect.
   b. Command:
      I will lead the platoon initially.

Are there any questions?

The time is________________________

FRAGMENTARY ORDERS

1. Issued at Base Camp after completion of RTP #1.

   Aggressor troops have been reported in the area along the trail leading from CP 6 to CP 23. The mission—to check the area around this trail for possible enemy activity. Move North on East Range Road to CP 6, then East to CP 23. Maintain speed of 20 MPH on road. Depart at two (2) minute intervals. (NOTE TO PLATOON LEADER: Platoon leader will assure that tanks move out at two minute intervals.)

2. Issued after lead vehicle reaches CP 23.

   Proceed along this tank trail to CP 8. When you meet dismounted troops, stop, and then proceed according to their instructions. (NOTE TO PLATOON LEADER: In those instances where you anticipate that there will be a delay of more than five (5) minutes, dismount the tank crews and instruct them to perform During Operations checks on the outsides of their vehicles, but do not attempt to score this activity. This is for the purpose of keeping the crews busy, only, and is most likely to be required between Base Camp and the Passive Surveillance Exercise.)

3. Issued as first tank reaches the junction of trails at PK 374529.

   (NOTE TO PLATOON LEADER: It may be necessary to halt the column at this point until all tanks have caught up, in order to avoid losing tanks.) Aggressor activity reported in vicinity of CP 2. Our mission—to perform an area reconnaissance up to and around CP 2.

4. Issued after platoon has completed area reconnaissance.

   Set up a hasty defensive position at CP 2. We will resupply with ammunition as quickly as possible. Report when ready to move.

5. Issued after platoon has finished loading the blank ammunition and reported that they are ready to move.

   Aggressor troops have been reported in the vicinity of CP 8 and CP 9. Proceed cautiously to CP 8 and maintain surveillance of the area between CP 8 and CP 9. Move out in column formation.

6. Issued as soon as aggressor action begins.

   Echelon left! Take under fire!

7. Issued when aggressor withdraws.

   Resume column formation and continue on the mission.

8. Issued before platoon reaches junction of trails at PK 374529.

   Our advance units report presence of minefields vicinity of CP 8. They have marked some of them. Dismounted troops at the minefield will accompany you through (NOTE TO PLATOON LEADER: Supplemental commands will be required to get the platoon to the cleared lane in the minefield.)

9. Issued after first tank gets through minefield.
   Move to a position in the clearing between CP 9 and CP 13. We are to maintain a surveillance watch for aggressor activity. First platoon reports elements of aggressor 75th recon company have gotten through the screen—the last seen at CP 50.

10. Issued after platoon has finished Passive Surveillance Exercise.
    Aggressor armor elements have gotten across Owl Creek and are moving South. Move to CP 1 through CP 13, CP 10, CP 3, and CP 20.

11. Issued at CP 1.
    Third platoon reports aggressor activity along East Range Road—aggressor air elements strafing road. Move out at two (2) minute intervals—maintain speed of 20 MPH. Await further orders at CP 25. Return all ground fire while continuing to move.
    (NOTE TO PLATOON LEADER: Platoon leader will assure that tanks move out at two (2) minute intervals.)

12. Issued after platoon has finished firing Gunnery Exercise and is assembled at CP 25.
    Aggressor is falling back. We will move to Base Camp, North along East Range Road. Scattered aggressor forces are still operating behind our lines, and air elements are strafing the road. You will maintain surveillance along the road and return all ground fire while continuing to move. Maintain two (2) minute interval between vehicles. Maintain speed of 20 MPH. Move out.
    (NOTE TO PLATOON LEADER: Platoon leader will assure that two (2) minute interval between vehicles is maintained.)

13. Issued at Base Camp when ready to move out.
    Supply trucks moving on East Range Road report activity on tank trail vicinity of CP 6. Reconnoiter trail from Base Camp to CP 23, going through CP 6. Maintain interval of two (2) minutes between vehicles. Maintain speed of 10 MPH. Use BO Drive throughout hours of darkness, while moving.

14. Issued after lead vehicle reaches CP 23.
    Proceed along this trail to CP 8. Watch for dismounted troops, stop and then proceed according to their instructions.
    (NOTE TO PLATOON LEADER: In those instances where you anticipate that there will be a delay of more than five (5) minutes, dismount the crews from the tanks and instruct them to perform During Operations checks on the outside of their vehicles, but do not attempt to score these. This is for the purpose of keeping the crews busy, only, and is most likely to be required between Base Camp and the Passive Surveillance Exercise.)

15. Issued as first tank reaches the junction of trails at PK 374529.
    (NOTE TO PLATOON LEADER: It may be necessary to halt the column at this point until all tanks have caught up, to avoid losing tanks.)
    Minefields in vicinity of CP 8. One is marked. Dismounted troops will accompany you through.
    (NOTE TO PLATOON LEADER: Supplemental commands may be required to get the platoon through the minefield.)

16. Issued after first tank has passed through the minefield.
    Move to a position in the clearing between CP 9 and CP 13. We will maintain a surveillance watch for aggressor activity. Aggressor is trying to infiltrate under cover of darkness. Use infrared for your surveillance watch.

17. Issued after platoon has finished Passive Surveillance Exercise.
Move out through CP 13, CP 10, CP 3, and CP 20 to CP 1. Use BO Drive.

18. Issued at CP 1.
Aggressor is trying to infiltrate. We will set up ambush position vicinity of CP 25. Maintain interval of two (2) minutes between vehicles. Maintain speed of 15 MPH. Await further orders at CP 25. If you are fired upon, illuminate ground targets with searchlight while continuing to move, but do not return fire.

19. Issued after platoon has completed Gunnery Exercise.
Proceed back to Base Camp north along East Range Road. Aggressor activity reported along road. If you are fired upon, illuminate ground targets with searchlight while continuing to move, but do not return fire. Maintain interval of two (2) minutes between vehicles and speed of 15 MPH. Move out.

**FRAGMENTARY ORDERS FOR THE SECOND DAY
WILL BE THE SAME AS THOSE ABOVE**

Appendix C

PERSONNEL DATA

Personnel Data[1]

Crew Number	Position	Rank	Age	Time in Service (Months)	Time on Job (Months)	GT Score
Control Group I						
1	Tank Commander	SSG	26	114	48.0	100
	Gunner	SP4	21	15	5.0	114
	Driver	SP4	21	29	.7	128
	Loader	SP4	21	17	.5	117
2	Tank Commander	SP5	21	23	4.0	127
	Gunner	SP4	23	17	12.0	75
	Driver	PFC	20	13	2.0	105
	Loader	SP4	21	22	5.0	126
3	Tank Commander	SGT	20	8	1.0	115
	Gunner	SP5	21	35	.7	105
	Driver	PFC	21	14	3.0	89
	Loader	SP4	24	13	.7	95
4	Tank Commander	SP5	21	23	.7	110
	Gunner	SP4	20	20	.7	81
	Driver	SP4	20	13	.7	100
	Loader	SP4	21	30	.7	75
5	Tank Commander	SGT	21	30	17.0	118
	Gunner	SP5	22	24	5.0	120
	Driver	SP4	21	19	5.0	104
	Loader	SP4	20	18	.7	98
Control Group II						
1	Tank Commander	E-6	39	144	3.0	–
	Gunner	SP5	22	36	4.0	97
	Driver	SP4	22	27	2.0	96
	Loader	PFC	20	14	.1	95
2	Tank Commander	SGT	18	8	.5	136
	Gunner	SP5	22	19	1.0	115
	Driver	SP4	22	14	.2	97
	Loader	PFC	21	15	.5	98
3	Tank Commander	SGT	19	10	1.2	122
	Gunner	SP5	20	24	.5	122
	Driver	SP4	23	74	.5	111
	Loader	SP5	26	96	.5	90

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[1] Men in both the Control and Experimental groups had from 6 to 12 years of education, except for one who also had one year of college.

Crew Number	Position	Rank	Age	Time in Service (Months)	Time on Job (Months)	GT Score
Control Group II *(Continued)*						
4	Tank Commander	SP5	21	30	13.0	110
	Gunner	SP4	21	46	.5	107
	Driver	PVT	20	12	.5	129
	Loader	PFC	20	12	.5	92
5	Tank Commander	SGT	20	10	1.0	131
	Gunner	SP4	24	44	.1	131
	Driver	PFC	21	12	4.0	104
	Loader	PFC	21	14	.1	87
Experimental Group I						
1	Tank Commander	SGT	23	45	.2	100
	Gunner	SP5	20	21	.2	90
	Driver	PFC	21	30	.2	128
	Loader	SP4	22	24	.2	91
2	Tank Commander	SGT	23	30	.2	103
	Gunner	PFC	20	12	6.0	103
	Driver	PFC	22	9	.2	124
	Loader	SP4	27	21	6.0	–
3	Tank Commander	SGT	19	9	2.0	–
	Gunner	SP4	20	18	12.0	108
	Driver	PFC	27	9	1.0	–
	Loader	PVT	24	21	6.0	76
4	Tank Commander	SGT	20	12	6.0	126
	Gunner	PVT	21	15	9.0	67
	Driver	SP4	22	12	6.0	69
	Loader	SP4	21	12	3.0	–
5	Tank Commander	SGT	22	30	12.0	100
	Gunner	SP4	20	30	1.0	–
	Driver	SP4		21	6.0	60
	Loader	PFC	20	30	12.0	89
Experimental Group II						
1	Tank Commander	SSG	27	108	18.0	115
	Gunner	SGT	22	33	5.0	126
	Driver	SP4	21	35	1.0	100
	Loader	PVT	21	25	5.0	113
2	Tank Commander	SGT	21	33	8.0	115
	Gunner	PFC	26	14	1.0	90
	Driver	SP4	21	21	6.0	127
	Loader	PFC	19	20	4.0	112
3	Tank Commander	SGT	21	22	6.0	111
	Gunner	SGT	20	24	5.0	125
	Driver	SP4	21	41	5.0	127
	Loader	SP4	20	14	1.0	85

Crew Number	Position	Rank	Age	Time in Service (Months)	Time on Job (Months)	GT Score
Experimental Group II *(Continued)*						
4	Tank Commander	SGT	22	21	5.0	105
	Gunner	SP4	27	66	5.0	88
	Driver	PFC	21	14	1.0	110
	Loader	PVT	20	33	1.0	100
5	Tank Commander	SGT	21	8	1.0	126
	Gunner	SP5	21	20	2.0	125
	Driver	SP4	20	14	3.0	89
	Loader	PFC	23	12	5.0	80
Experimental Group III						
1	Tank Commander	SSG	43	168	5.0	122
	Gunner	PFC	22	12	6.0	138
	Driver	SP4	23	23	1.0	100
	Loader	PFC	20	16	8.0	80
2	Tank Commander	SGT	21	12	1.5	115
	Gunner	PFC	30	96	3.0	93
	Driver	SP4	20	24	5.0	90
	Loader	PFC	20	18	3.0	127
3	Tank Commander	SGT	21	10	1.5	112
	Gunner	SP4	21	30	5.0	118
	Driver	SP4	21	30	5.0	108
	Loader	PFC	18	10	5.0	106
4	Tank Commander	SSG	26	84	9.0	91
	Gunner	SGT	22	30	5.0	110
	Driver	SP4	20	17	12.0	118
	Loader	PVT	22	14	5.0	53
5	Tank Commander	SGT	19	12	1.5	109
	Gunner	PFC	21	12	3.0	100
	Driver	PFC	19	12	5.0	100
	Loader	PVT	20	30	3.0	86
Experimental Group IV						
1	Tank Commander	PSG	36	192	108.0	90
	Gunner	SGT	18	9	9.0	89
	Driver	SGT	22	36	5.0	81
	Loader	SP4	20	12	8.0	92
2	Tank Commander	SSG	32	168	9.0	104
	Gunner	PVT	20	18	6.0	107
	Driver	SP4	26	21	6.0	60
	Loader	PFC	19	18	.2	–
3	Tank Commander	SGT	21	24	6.0	105
	Gunner	SP5	20	30	1.0	121
	Driver	SP4	24	18	.2	–
	Loader	SP4	19	21	6.0	70

Crew Number	Position	Rank	Age	Time in Service (Months)	Time on Job (Months)	GT Score
Experimental Group IV *(Continued)*						
4	Tank Commander	SGT	22	32	5.0	95
	Gunner	SP4	20	17	.2	95
	Driver	PFC	20	12	4.0	98
	Loader	PFC	22	12	4.0	125
5	Tank Commander	SGT	32	180	4.0	110
	Gunner	PFC	21	14	4.0	105
	Driver	SP4	21	35	11.0	105
	Loader	SP4		23	2.0	91

Appendix D

ANALYSIS OF VARIANCE
SUMMARY TABLES

Table D-1

Analysis of Variance of Communication Accuracy Scores

Source of Variation	*df*	Mean Square	*F*	*P*
RTP 1 + 4				
Between Subjects				
Groups	1	270.94	2.93	NS
Error	28	92.35		
Within Subjects				
12-hour periods	3	60.29	<1	NS
Groups x periods	3	56.55	<1	NS
Error	84	99.59		
RTP 2 + 5				
Between Subjects				
Groups	1	2.02	<1	NS
Error	28	458.21		
Within Subjects				
12-hour periods	3	103.66	<1	NS
Groups x periods	3	190.41	1.20	NS
Error	84	158.34		
RTP 3 + 6				
Between Subjects				
Groups	1	101.40	<1	NS
Error	28	175.68		
Within Subjects				
12-hour periods	3	90.23	<1	NS
Groups x periods	3	31.67	<1	NS
Error	84	136.91		

Table D-2

Analysis of Variance of Communication Time Scores

Source of Variation	*df*	Mean Square	*F*	*P*
RTP 1 + 4				
Between Subjects				
Groups	1	5087.60	1.35	NS
Error	28	3757.45		
Within Subjects				
12-hour periods	3	2737.10	1.42	NS
Groups x periods	3	2255.05	1.17	NS
Error	84	1924.72		
RTP 2 + 5				
Between Subjects				
Groups	1	78988.81	6.17	<.05
Error	28	12794.22		
Within Subjects				
12-hour periods	3	7775.14	1.42	NS
Groups x periods	3	3352.92	<1	NS
Error	84	5459.76		
RTP 3 + 6				
Between Subjects				
Groups	1	22446.01	7.53	<.05
Error	28	2982.51		
Within Subjects				
12-hour periods	3	2302.60	1.12	NS
Groups x periods	3	2130.37	1.04	NS
Error	84	2054.48		

Table D-3

Analysis of Variance of Driving Accuracy Scores

Source of Variation	*df*	Mean Square	*F*	*P*
Log Obstacle				
Between Subjects				
Groups	1	.14	<1	NS
Error	28	.93		
Within Subjects				
12-hour periods	3	6.87	8.70	
Groups x periods	3	1.62	2.05	NS
Error	84-6[a]	.79		
Ditch Crossing				
Between Subjects				
Groups	1	5.40	5.14	<.05
Error	28	1.05		
Within Subjects				
12-hour periods	3	.59	<1	NS
Groups x periods	3	.81	<1	NS
Error	84-1[a]	.83		
Slalom				
Between Subjects				
Groups	1	1.34	4.47	.05
Error	28	.30		
Within Subjects				
12-hour periods	3	.38	1.27	NS
Groups x periods	3	.38	1.27	NS
Error	84-2[a]	.30		
Mine Field[b]				
Between Subjects				
Group	1	4.17	<1	NS
Error	23	9.93		
Within Subjects				
12-hour periods	3	7.92	2.66	NS
Groups x periods	3	1.96	<1	NS
Error	69	2.98		

[a] Missing scores were replaced with group mean. The reduced number of *df* was used in calculation of the Error Mean Square and for entering the table of *F*.

[b] Invalid scores for five tanks in the experimental group not included in the analysis.

Table D-4

Analysis of Variance of Driving Time Scores

Source of Variation	*df*	Mean Square	*F*	*P*
Log Obstacle				
Between Subjects				
Groups	1	2100.42	6.82	<.05
Error	28	307.95		
Within Subjects				
12-hour periods	3	182.17	1.56	NS
Groups x periods	3	218.12	1.87	NS
Error	84-6[a]	116.72		
Ditch Crossing				
Between Subjects				
Groups	1	1460.27	5.74	<.05
Error	28	254.61		
Within Subjects				
12-hour periods	3	145.62	<1	NS
Groups x periods	3	318.11	1.46	NS
Error	84-1[a]	218.40		
Slalom				
Between Subjects				
Groups	1	84.02	1.19	NS
Error	28	70.75		
Within Subjects				
12-hour periods	3	408.90	5.25	<.05
Groups x periods	3	33.05	<1	NS
Error	84-2[a]	77.82		
Mine Field[b]				
Between Subjects				
Groups	1	98.41	<1	NS
Error	23	5828.97		
Within Subjects				
12-hour periods	3	7384.46	3.16	<.05
Groups x periods	3	4130.5	1.77	NS
Error	69	2339.10		

[a] Missing scores were replaced with group mean. The reduced number of *df* was used in calculation of the Error Mean Square and for entering the table of *F*.

[b] Invalid scores for five tanks in the experimental group were not included in the analysis.

Table D-5

Analysis of Variance of Passive Surveillance Detection Scores

Source of Variation	*df*	Mean Square	*F*	*P*
Tanks				
Between Subjects				
Groups	1	4.03	3.57	NS
Error	28	1.13		
Within Subjects				
12-hour periods	1	.15	<1	NS
Groups x periods	1	.30	<1	NS
Error	28	.79		
1/4 Ton				
Between Subjects				
Groups	1	1.20	1.01	NS
Error	28	1.19		
Within Subjects				
12-hour periods	1	.27	<1	NS
Groups x periods	1	.53	<1	NS
Error	28	.58		
Troops				
Between Subjects				
Groups	1	2.70	3.30	NS
Error	28	.82		
Within Subjects				
12-hour periods	1	5.40	7.38	<.05
Groups x periods	1	1.20	1.74	NS
Error	28	.69		

Table D-6

Analysis of Variance of Passive Surveillance Detection Time Scores

Source of Variation	*df*	Mean Square	*F*	*P*
	Tanks			
Between Subjects				
Groups	1	25301.01	2.14	NS
Error	28	1184.54		
Within Subjects				
12-hour periods	1	147.26	<1	NS
Groups x periods	1	4.41	<1	NS
Errors	28	987.51		
	1/4 Ton			
Between Subjects				
Groups	1	991.88	<1	NS
Error	28	1375.13		
Within Subjects				
12-hour periods	1	64.07	<1	NS
Groups x periods	1	2009.00	5.06	<.05
Error	28	396.96		
	Troops			
Between Subjects				
Groups	1	2332.01	3.78	NS
Error	28	617.60		
Within Subjects				
12-hour periods	1	2208.26	8.05	<.05
Groups x periods	1	1147.01	4.18	NS
Error	28	274.20		

Table D-7

Analysis of Variance of Moving Surveillance Detection Scores

Source of Variation	*df*	Mean Square	*F*	*P*
Between Subjects				
Groups	1	8.07	3.50	NS
Error	28	2.30		
Within Subjects				
12-hour periods	3	3.25	3.32	<.05
Group x periods	3	4.49	4.58	<.05
Error	84	.98		

Table D-8

Analysis of Variance of Time and Hit Scores for Gunnery Phase I: Main Gun

Source of Variation	*df*	Mean Square	*F*	*P*
Time to 1st Round				
Between Subjects				
Groups	1	9200.82	1.04	NS
Error	28	8832.02		
Within Subjects				
12-hour periods	3	15824.9	2.73	<.05
Groups x periods	3	11941.18	2.06	NS
Error	84	5805.16		
Hits (3 targets combined)				
Between Subjects				
Groups	1	3.50	<1	NS
Error	28	7.84		
Within Subjects				
12-hour periods	3	9.70	2.05	NS
Groups x periods	3	2.42	<1	NS
Error	84	4.74		

Table D-9

Analysis of Variance of Accuracy Rating Scores Gunnery Phase II: Coaxial Machine Gun (3 Targets Combined)

Source of Variation	*df*	Mean Square	*F*	*P*
Between Subjects				
Groups	1	.01	<1	NS
Error	28	8.15		
Within Subjects				
12-hour periods	3	8.94	1.87	NS
Groups x periods	3	4.52	<1	NS
Error	84	4.78		

Table D-10

Analysis of Variance of Accuracy Rating and Time Scores for Gunnery Phase III: Caliber .50 Machine Gun

Source of Variation	*df*	Mean Square	*F*	*P*
Time to First Round				
Between Subjects				
Groups	1	1041.67	3.37	NS
Error	28	309.52		
Within Subjects				
12-hour periods	3	1957.72	6.31	<.05
Groups x periods	3	787.61	2.54	NS
Error	84	310.38		
Accuracy Rating				
Between Subjects				
Groups	1	.33	<1	NS
Error	28	4.51		
Within Subjects				
12-hour periods	3	13.07	4.82	<.05
Groups x periods	3	4.54	1.68	NS
Error	84	2.71		

Table D-11

Analysis of Variance of Time and Hit Scores for Gunnery Phase III: Main Gun

Source of Variation	*df*	Mean Square	*F*	*P*
Time to 1st Round				
Between Subjects				
Groups	1	3.50	<1	NS
Error	28	79.26		
Within Subjects				
12-hour periods	3	148.01	2.51	NS
Groups x periods	3	2.27	<1	NS
Error	84	58.86		
Hit Scores				
Between Subjects				
Groups	1	1.08	<1	NS
Error	28	6.08		
Within Subjects				
12-hour periods	3	5.41	1.37	NS
Groups x periods	3	2.86	<1	NS
Error	84-5[a]	3.94		

[a] Hit scores of one platoon of the control group were invalid for Night I because of the fog. Missing scores were replaced with the mean score of the second platoon. Reduced *df* were used in calculation of the Error Mean Square and for entering the table of *F*.

Table D-12

Analysis of Variance of Maintenance Accuracy and Time Scores

Source of Variation	*df*	Mean Square	*F*	*P*
	Accuracy			
Between Subjects				
Groups	1	10.00	2.35	NS
Error	28	4.26		
Within Subjects				
12-hour periods	3	4.99	2.88	<.05
Groups x period	3	2.33	1.35	
Error	84	1.73		
	Time			
Between Subjects				
Groups	1	164379.01	1.21	NS
Error	28	135881.58		
Within Subjects				
12-hour periods	3	44994.23	<1	NS
Groups x periods	3	22702.54	<1	NS
Error	84-1[a]	214471.29		

[a] Missing scores were replaced with group means. Reduced *df* were used in calculation of the Error Mean Square and for entering the table of *F*.

Distribution List

2	DIR OASD MANPOWER (PP&GR)
1	CHF DASA ATTN DOC LIB BR
1	DIR WSEG WASH., D.C. 20305
1	DIR OASD MANPOWER & RESERVE AFFAIRS
1	OFC OF THE ASST SEC OF DEF (M&RA) ATTN SPEC ASST POLICY STUDIES
2	COMDR FLD COMD DEF ATOMIC SPT AGY SANDIA BASE ATTN FCTG7
2	NASA SCI & TECH INFO FACILITY COLLEGE PARK MD
1	CINC US EUROPEAN COMD ATTN SUPPORT PLANS BR J3
1	CINC USA PACIFIC ATTN G3 CDC APO SAN FRAN 96610
1	CG US ARMY JAPAN APO 96343 SAN FRAN ATTN G3
10	CG USA FORCES SOUTHERN COMD ATTN SCARCD CZ
2	CG USA ALASKA ATTN ARACD APO 98749 SEATTLE
2	CG US ARMY EUROPE APO 09403 NY ATTN OPNS DIV
1	CO ARMY TRANS RES COMD FT EUSTIS ATTN TECH LIB
1	CG USA AD COMD ENT AFB ATTN ADGPA COLO
6	CG 1ST ARMY ATTN DCSOT FT MEADE MD
1	CG 3RD ARMY ATTN DCSOT FT MCPHERSON
2	CG SIXTH ARMY PRES OF SAN FRAN ATTN AMOPS-T2
1	CG EUSA ATTN AG-AC APO 96301 SAN FRAN
2	CG EUSA ATTN G-3 APO 96301 SAN FRAN
1	CLIN PSYCHOL SERV DEPT OF NEUROPSYCHIAT WALTER REED GEN HOSP
1	DIR HEL APG MD
1	CG USA CDC EXPERIMENTATION COMD FT ORD
2	ENGNR PSYCHOL LAB PIONEERING RES DIV ARMY NATICK LABS NATICK MASS
4	TECH LIB ARMY NATICK LABS NATICK MASS
3	CO DEF DEVEL ENGNR LAB EDGEWOOD ARSENAL ATTN LIBN
2	INST OF LAND CBT ATTN TECH LIB FT BELVOIR VA
1	CO USA CDC CBR AGCY ALA
1	REDSTONE SCIENTIFIC INFC CTR US ARMY MSL COMD ATTN CHF DOC SEC ALA
1	CO FT HUACHUCA SPT COMD USA ATTN TECH REF LIB
2	CG US ARMY CDC EXPERIMENTATION COMD FT ORD
1	SIXTH USA LIB DEPOT BLDG M 13 14 PRES OF SAN FRAN
1	CHF DEPT OF CLIN & SOC PSYCH WALTER REED ARMY INST OF RES WASH D C
1	PLNS OFCR PSYCH HDQTRES USACDCEC FT ORD
5	CG FT ORD ATTN G3 TNG DIV
1	CO DUGWAY PG UTAH ATTN TECH LIB
1	DIR WALTER REED ARMY INST OF RES WALTER REED ARMY MED CTR
2	DIR WRAIR WALTER REED ARMY MED CTR ATTN NEUROPSYCHIAT DIV
1	CO HQ ARMY ENLISTED EVAL CTR FT BENJ HARRISON
1	TECH LIB BOX 22 USACDC EXPERIMENTATION COMD FT ORD
1	HUMAN FACTORS TEST DIV (ADMZ) USAF HOSP EGLIN AFB
1	CO USA MOBILITY EQUIP R&D CTR ATTN TECH DOC CTR FT. BELVOIR
1	CO FRANKFORD ARSNL ATTN SMUFA-N6400/202-4 PA
3	6TH RGN USARADCOM FT BAKER
1	4TH ARMY MSL COMD AIR TRANSPORTABLE SAN FRAN
1	DIR ARMY BD FOR AVN ACCIDENT RSCH FTRUCKER
2	CO PICATINNY ARSNL DOVER N J ATTN SUMPA VCI
1	LIB DEF SUPPLY AGCY CAMERON STA VA
2	CO USA CDC AG AGCY FT BENJ HARRISON IND
1	REF M MS IS NASA ALA
1	CO USA CBT DEVEL COMD TRANS AGCY FT EUSTIS
1	CO ARMY CDC INF AGY FT BENNING
1	CO ARMY CDC ARMOR AGY FT KNOX
8	USA CDC SPEC WARFARE AGENCY FT BRAGG
1	CO US ARMY CDC AVN AGCY FT RUCKER
1	DIR OF INTERN TNG USA LOG MGT CTR FT LEE
3	CO USA CDC CBT SUPPORT GP FT BELVOIR
3	CO USA TNG CTR (FA) ATTN AKPSITC-TT FT SILL
1	CG USA TNG CTR & FT LEONARD WOOD ATTN ACOFS G3
1	CG USA INF CTR ATTN AJIGT-T FT BENNING
1	CG USA TNG CTR INF ATTN ACOFS G3 FT DIX
1	CG USA TNG CTR ATTN ACOFS G3 FT JACKSON
1	CG USA TNG CTR INF ATTN ACOFS G3 FT LEWIS
1	CG USA TNG CTR INF & FT ORD ATTN ACOFS G3
39	CG USA TNG CTR INF ATTN ACOFS G3 FT POLK
5	CO USA MED TNG CTR ATTN DIR OF TNG FT SAM HOUSTON
20	CG USA AD CTR ATTN G3 FT BLISS
1	CG USA TNG CTR INF ATTN ACOFS G3 FT CAMPBELL
3	LIB ARMY WAR COLL CARLISLE BKS
1	COMDT USA INTELL SCH ATTN AHBH-S-AO FT HOLABIRD
1	COMDT COMD + GEN STAFF CO FT LEAVENWORTH ATTN ARCHIVES
1	DIR OF MILIT PSYCHOL + LDRSHP US MILIT ACAD WEST POINT
1	US MILIT ACAD WEST POINT ATTN LIB
1	COMDT ARMY AVN SCH ATTN DIR OF INSTR FT RUCKER
2	COMDT ARMY SECUR AGY TNG CTR + SCH FT DEVENS ATTN LIB
1	STIMSON LIB MED FLD SERV SCH BROOKE ARMY MED CTR FT SAM HOUSTON
10	COMDT THE ARMOR SCH ATTN DOI FT KNOX
1	COMDT ARMY ARMOR SCH FT KNOX ATTN WEAPONS DEPT
1	COMDT USA CHAPLAIN SCH ATTN DOI FT HAMILTON
1	COMDT ARMY CHEM CORPS SCH FT MCCLELLAN ATTN EDUC ADV
1	COMDT USA FIN SCH ATTN CHF DOC DEV LIT PLN DIV ODDI IND
1	USA FINANCE SCH FT BENJ HARRISON ATTN EDUC ADV
4	COMDT ADJ GEN SCH FT BENJ HARRISON ATTN EDUC ADV
1	COMDT USAIS ATTN EDUC ADV FT BENNING
1	COMDT USAIS ATTN AJIIS-D-EPRD FT BENNING
1	HQ US ARMY ADJ GEN SCH FT BENJ HARRISON ATT COMDT
1	LIB ARMY QM SCH FT LEE
1	COMDT USA QM SCH FT LEE ATTN EDUC ADV
1	COMDT ARMY TRANS SCH FT EUSTIS ATTN EDUC ADV
1	CO USA SEC AGY TNG CTR & SCH ATTN IATEV RSCH ADV FT DEVENS
1	COMDT USA MIL POLICE SCH ATTN PLNS &PROG ODDI FT GORDON
2	COMDT US ARMY SOUTHEASTERN SIG SCH ATTN EDUC ADV FT GORDON
1	COMDT USA AD SCH ATTN DOI FT BLISS
1	CO USA ORD CTR & SCH OFC OF OPS ATTN AHBN-O APG MD
5	ASST COMDT ARMY AIR DEF SCH FT BLISS ATTN CLASSF TECH LIB
3	CG USA FLD ARTY CTR & FT SILL ATTN AVN OFCR
1	COMDT DEF INTELL SCH ATTN SI&AS DEPT
1	COMDT ARMED FORCES STAFF COLL NORFOLK
1	COMDT USA SIG CTR & SCH ATTN DOI FT MONMOUTH
1	COMDT JUDGE ADVOCATE GENERALS SCH U OF VA
1	DPTY COMDT USA AVN SCH ELEMENT GA
1	DPTY ASST COMDT USA AVN SCH ELEMENT GA
1	USA AVN SCH ELEMENT OFC OF DIR OF INSTR ATTN EDUC ADV GA
1	EDUC CONSLT ARMY MILIT POLICE SCH FT GORDON
6	COMDT USA ENGR SCH ATTN EDUC ADV AHBBES-EA FT BELVOIR
2	COMDT USA SCH EUROPE ATTN EDUC ADV APO 09172 NY
1	OFC OF DOCTRINE DEV LIT & PLNS USA ARMOR SCH ATTN AHBAAS-DM
1	COMDT ARMY AVN SCH FT RUCKER ATTN EDUC ADV
1	DIR OF INSTR US MIL ACAD WEST POINT NY
1	DIR OF MILIT INSTR US MILIT ACAD WEST POINT
1	USA INST FOR MIL ASSIST ATTN LIB BLDG 1ST2808 FT BRAGG
4	USA INST FOR MIL ASSIST ATTN COUNTERINSURGENCY DEPT FT BRAGG
1	COMDT DEF MGT SCH FT BELVOIR
2	COMDT USA MSL & MUN CTR & SCH ATTN CHF OFC OF OPS REDSTONE ARSNL
2	COMDT US WAC SCH US WAC CTR ATTN AJMCT FT MCCLELLAN
2	HQ ABERDEEN PG ATTN TECH LIB
1	CO USA INTELL CTR & SCH ATTN DIR OF ACADEMIC OPS FT HUACHUCA
1	CO USA INTELL CTR & SCH ATTN DIR OF DOC & LIT FT HUACHUCA
1	COMDT USA C&GSC OFC OF CHF OF RESIDENT INSTR FT LEAVENWORTH
1	COMDT USA CA SCH ATTN OFC OF DOCTRINE DEVEL LIT & PINS FT GORDON
1	COMDT USA CA SCH ATTN DCI FT GORDON
1	COMDT USA CA SCH ATTN EDUC ADV FT GORDON
1	COMDT USA CA SCH ATTN LIB FT GORDON
1	COMDT USA SCH & TNG CTR ATTN ACOFS G3 TNG DIV FT MCCLELLAN
1	COMDT USA SCH & TNG CTR ATTN ACOFS G3 PLNS & OPS DIV FT MCCLELLAN
10	COMDT USA INST FOR MIL ASSIST ATTN DOI FT BRAGG
8	COMDT USA FLD ARTY SCH ATTN DOI FT SILL
1	COMDT USA ARTY SCH ATTN EDUC SERVICES DIV FT SILL
1	COMDT USA ARTY SCH ATTN EDUC ADV FT SILL
1	COMDT USA TRANS SCH ATTN DIR OF DOC & LIT FT EUSTIS
1	COMDT USA TRANS SCH ATTN LIB FT EUSTIS
1	USA INST FOR MIL ASST ATTN EDUC ADV FT BRAGG
1	COMDT USA C&GSC ATTN ATSCS-DJ (SPWAR)
1	COMDT ARMY QM SCH OFC DIR OF NONRESID ACTVY ATTN TNG MEDIA DIV VA
1	COMDT USA ARTY SCH ATTN LIB FT SILL
1	CG USA SCH & TNG CTR ATTN ACOFS G3 FT GORDON
1	DIR OF GRAD STUD & RSCH ATTN BEHAV SCI REP USAC&GSC
1	COMDT USA AD SCH ATTN AKBAAS-DL-EA FT BLISS
1	COMDT USA AD SCH HIGH ALTITUDE MSL DEPT FT BLISS
2	DIR BRGD + BN OPNS DEPT USAIS FT BENNING
1	DIR COMM ELEC USAIS FT BENNING
1	DIR ABN-AIR MOBILITY DEPT USAIS FT BENNING
2	DIR COMPANY TACTICS DEPT USAIS FT BENNING
1	CG USA SIG CTR & SCH ATTN ATSSC-DP-COB FT MONMOUTH
1	CG USA SIG CTR & SCH ATTN ATSSC-EA FT MONMOUTH
1	SECY OF ARMY, PENTAGON
1	DCS-PERS DA ATTN CHF C+S DIV
1	DIR OF PERS STUDIES & RSCH ODCSPER DA WASH DC
2	ACSFOR DA ATTN CHF TNG DIV WASH DC
1	CG USA MAT COMD ATTN AMCRD-TE
1	CHF OF ENGNRS DA ATTN ENGTE-T
1	HQ ARMY MAT COMD R+D DRCTE ATTN AMCRD-RC
1	CHF OF PERS OPNS PERS DRCTE DA ATTN OPSC
1	CLIN PSYCHOL CONSLT OFC OF CHF PSYCHIAT & NEUROL CONSLT
2	CG ARMY MED R+D COMD ATTN BEHAV SCI RES BR
1	US ARMY BEHAVIOR & SYS RSCH LAB ATTNCRD-AR ARL VA
1	OPO PERS MGT DEV OFC ATTN MOS SEC (NEW EQUIP) OPOMD
1	PROVOST MARSHAL GEN DA
1	DIR CIVIL AFFAIRS DRCTE ODCSOPS
1	OFC RESERVE COMPON DA
2	CG USA SEC AGCY ARL HALL STA ATTN AC OF S G1 VA
12	ADMIN DDC ATTN: TCA (HEALY) CAMERON STA ALEX., VA. 22314
1	CO US ARMY MED RES LAB FT KNOX
1	CHF OF R+D DA ATTN CHF TECH + INDSTR LIAISON OFC
1	CO USA CDC MED SERV AGCY FT SAM HOUSTON
2	CG ARMY MED R+D COMD ATTN MEDDH-SR
1	USA BEHAVIOR & SYS RSCH LAB ATTN CRD-AIC ARL VA
1	COMDT USA CBT SURVEIL SCH & TNG CTR ATT ED ADV FT HUACHUCA
1	COMDT USA CBT SURVEIL SCH & TNG CTR ATTN ORG DOC & NEW EQUIP ARIZ
2	TNG & DEVEL DIV ODCSPERS
1	COMDT USA CBT SURVEIL SCH & TNG CTR ATTN 1ST CBT TNG BDE ARIZ
1	CAREER MGT BR ATTN R DETIENNE CAMERON STA ALEX VA
1	USA LIB DIV-TAGO ATTN ASDIRS
2	PRES ARMY ARMOR BD FT KNOX
1	PRES ARMY INF BD FT BENNING ATTN FE+SP DIV
1	PRES ARMY MAINT BD FT KNOX
2	PRES ARMY ARTY BD FT SILL
5	CG CONARC ATTN ATIT-RD-RD FT MONROE
2	CG CONARC ATTN LIB FT MONROE
1	CO ARMY CBT DEVEL COMD MILIT POLICE AGY FT GORDON
1	USA ARCTIC TEST CTR CHF INSTR & TEST METH DIV SEATTLE
1	CHF USA AD HRU FT BLISS
1	CHF USA ARMOR HRU FT KNOX
1	CHF USA AVN HRU FT RUCKER
1	CHF USA INF HRU FT BENNING
1	CHF USA TNG CTR HRU PRES OF MONTEREY
1	CG 2D ARMORED DIV FT HOOD ATTN DIV AVN OFCR
10	CG 4TH ARMORED DIV ATTN DCSOT APO NY 09326
2	CO 194TH ARMORED BDE FT KNOX
5	CO 2D ARMORED CAV REGT APO 09693 NY
1	CO 3D ARMORED CAV REGT FT LEWIS
4	CO 14TH ARMORED CAV REGT ATTN AVN OFCR APO 09146 NY
1	1ST ARMORED DIV HQ & HQ CO FT HOOD ATTN AC OF S G2
10	CO 1ST BN 63RD ARMOR 1ST INF DIV ATTN S3 FT RILEY
8	CO 1ST BN 64TH ARMOR 3RD INF DIV ATTN S3 APO NY 09031
8	CO 2ND BN 68TH ARMOR 8TH INF DIV ATTN S3 APO NY 09034
1	CO COMPANY A 3D BN 32D ARMOR 3D ARMORED DIV APO NY
1	CO 5TH BN 33D ARMOR ATTN S3 FT KNOX
1	CO 3RD BN 68TH ARMOR 8TH INF DIV ATTN S3 APO NY 09028
1	CO 3RD BN 37TH ARMOR 4TH ARMORED DIV ATTN S3 APO NY 09066
1	CALIF NG 40TH ARMORED DIV LOS ANGELES ATTN AC OF SG3
1	55TH COMD HQ DIV ARMY NG JACKSONVILLE FLA
1	CG HQ 27TH ARMORED DIV NY AIR NG SYRACUSE
1	TEXAS NG 49TH ARMORED DIV DALLAS
3	CG ARMY ARMOR CTR FT KNOX ATTN G3 AIBKGT
1	CG 3RD INF DIV ATTN ACOFS G3 APO NY 09036
1	CG 7TH INF DIV ATT ACOFS G2 APO SAN FRAN 96207
1	CG 8TH INF DIV ATTN ACOFS G2 APO NY 09111
3	CG 4TH INF DIV (MECH) & FT CARSON ATTN ACOFS G3
1	DA HQS FT CARSON & HQS 4TH INF DIV (MECH) ATT MAJ HARRIS
3	CG 82ND ABN INF DIV ATTN ACOFS G3 FT BRAGG
1	CG XVIII ABN CORPS ATTN ACOFS G3 FT BRAGG
1	CO 197TH INF BRGD FT BENNING ATTN S3
1	CO 1ST BN (REINF) ATTN S3 FT MYER
7	CO 3RD BN 6TH INF REGT ATTN S3 APO NY 09742
1	CO 171ST INF BDE ATTN S3 APO SEATTLE 98731
1	CO 1ST BN 39TH INF 8TH INF DIV ATTN S3 APO NY 09034
1	CO 2ND BN 15TH INF 3RD INF DIV ATTN S3 APO NY 09026
5	CG 1ST INF DIV ATTN ACOFS G3 FT RILEY
4	CO 1ST BN (MECH) 52ND INF 198TH INF BDE ATTN S3 APO SAN FRAN 96219
1	CO 4TH BN (MECH) 54TH INF ATTN S3 FT KNOX
1	CO USA PARTIC GP USN TNG DEVICE CTR FLA
2	CONSOL RES GP 7TH PSYOP GP APO 96248 SAN FRAN
2	DA OFC OF ASST CHF OF STAFF FOR COMM-ELCT ATTN CETS-6 WASH
1	CG MILIT DIST OF WASHINGTON
2	DA USA ADV GP (ARNGUS) RALEIGH NC
1	USA RECRUITING COMD HAMPTON VA
1	SYS RES GP ENGNR EXPRM STA COLUMBUS O
1	DIR ARMY LIB PENTAGON
1	STRATEGIC PLANNING GP CORPS OF ENGNR ARMY MAP SERV
1	CHF OF MILIT HIST DA ATTN GEN REF BR
1	CO USA 10TH SPEC FORCES GP FT DEVENS
1	CO 24TH ARTY GP (AD) ATTN S3 RI
1	CG 31ST ARTY BDE AD ATTN S3 PA
1	CO 49TH ARTY GP AD ATTN S3 FT LAWTON
2	HQS 4TH BN 59TH ARTY REGT ATTN S3 NORFOLK
1	CO 28TH ARTY GP AD ATTN S3 SELFRIDGE AFB
1	HQ NIAGARA-BUFFALO DEF 31ST ARTY BRGD AIR DEF LOCKPORT
1	HQS 45TH ARTY BDE AD ATTN S3 ARL HTS ILL
1	CG 101ST ABN DIV (AIRMOBILE) ATTN ACOFS G3 APO SAN FRAN 96383
1	CG 1ST CAV (AIRMOBILE) ATTN ACOFS G3 APO SAN FRAN 96383
1	US ARMY GEN EQUIP ATTN TECH LIB FT LEE
1	US ARMY TROPIC TEST CTR PO DRAWER 942 ATTN BEHAV SCIEN CZ
1	CO ARMY RES OFC DURHAM
1	CO USAFAAC ATTN S3 FT SILL
10	CG III CORPS & FT HOOD ATTN G3 SEC FT HOOD
30	CO 1ST ARMORED DIV ATTN G3 SEC FT HOOD
30	CG 2D ARMORED DIV ATTN G3 SEC FT HOOD
25	CO 13TH SUPT BGDE ATTN S3 SEC FT HOOD
1	CG USAFAC & FT SILL ATTN AKPSIGT-TNTN
5	CO III CORPS ARTY ATTN G3 SEC FT SILL
15	CO 1ST AIT BGDE ATTN G3 SEC FT BLISS
8	CG USATCI & FT POLK ATTN AKPPO-DCOT
1	RSCH CONTRACTS & GRANTS BR ARO
1	BESD ARO OFC CHF OF R&D WASH DC
1	CHF OF R&D DA ATTN SCI INFO BR RSCH SPT DIV WASH DC
1	LIFE SCI DIV ARO ARL VA
1	CO HQS BN USAFAC & FT SILL ATTN S3
4	CO III CORPS ARTY ATTN S3 FORT SILL
1	CO USRAH ATTN S3 FT SILL
1	CG USAFACFS ATTN AKPSIAG-AS FT SILL
1	EACH PROF OF MILITARY SCI USA ROTC
1	CINC US ATLANTIC FLT CODE 312A USN BASE NORFOLK
1	CDR TNG COMMAND US PACIFIC FLT SAN DIEGO
1	CHF BUR OF MED + SURG DN ATTN CODE 513
1	CHF RES DIV BUR OF MED + SURG DN
1	HEAD CLIN PSYCHOL SECT PROFESNL DIV BUR OF MED + SURG DN
5	TECH LIB PERS 118 BUR OF NAV PERS ARL ANNEX
3	DIR PERS RES DIV BUR OF NAV PERS
1	TECH LIB BUR OF SHIPS CODE 210L NAVY DEPT
1	BUR OF YDS + DKS DN ATTN ASST CHF FOR RES DEVEL TEST + EVAL
1	ENGNR PSYCHOL BR ONR CODE 455 ATTN ASST HEAD WASH DC
3	CO + DIR NAV TNG DEVICE CTR ORLANDO ATTN TECH LIB
1	CO FLT ANTI-AIR WARFARE TNG SAN DIEGO
1	CO NUCLEAR WPNS TNG CTR PACIFIC US NAV AIR STA SAN DIEGO
1	CO NAV AIR DEVEL CTR JOHNSVILLE PENNA ATTN NADC LIB
2	CO FLT TNG CTR NAV BASE NEWPORT
1	CDR FLT TNG GP NAV BASE CHARLESTON
1	CO FLEET TNG CTR US NAV STA SAN DIEGO
1	CLIN PSYCHOL MENTAL HYGIENE UNIT US NAV ACAD ANNAPOLIS
1	PRES NAV WAR COLL NEWPORT ATTN MAHAN LIB
2	CO & DIR US ATLANTIC FLT ASW TACTICAL NORFOLK

1 CO NUCLEAR WEAPONS TNG CTR ATLANTIC NAV AIR STA NORFOLK
2 CO FLT SONAR SCH KEY WEST
1 CO FLT ANTI-SUB WARFARE SCH SAN DIEGO
1 CHF OF NAVL RSCH PERS & TNG BR (CODE 458) ARL VA
1 CHF OF NAV RES ATTN DIR PSYCHOL SCI DIV CODE 450
1 CHF OF NAV RES ATTN HEAD GP PSYCHOL BR CODE 452
1 DIR US NAV RES LAB ATTN CODE 5120
1 DIR NAVAL RSCH LAB ATTN LIB CODE 2029 WASH DC
1 CHF OF NAV AIR TNG TNG RES DEPT NAV AIR STA PENSACOLA
1 CO NAV SCH OF AVN MED NAV AVN MED CTR PENSACOLA
1 LIB NAV MED RES LAB NAV SUB BASE GROTON
1 CO MED FLD RES LAB CAMP LEJEUNE
1 CDR NAV MSL CTR POINT MUGU CALIF ATTN TECH LIB CODE 3022
1 DIR AEROSPACE CREW EQUIP LAB NAV AIR ENGNR CTR PA
1 OIC NAV PERS RES ACTVY SAN DIEGO
1 NAV NEUROPSYCHIAT RES UNIT SAN DIEGO
2 NAVAL MSL CTR (CODE 5342) PT MUGU CALIF
1 DIR PERS RES LAB NAV PERS PROGRAM SUPPORT ACTIVITY WASH NAV YD
1 NAV TNG PERS CTR NAV STA NAV YD ANNEX CODE 83 ATTN LIB WASH
4 COMDT MARINE CORPS HQ MARINE CORPS ATTN CODE AO-1B
1 HQ MARINE CORPS ATTN AX
1 DIR MARINE CORPS EDUC CTR MARINE CORPS SCH QUANTICO
1 DIR MARINE CORPS INST ATTN EVAL UNIT
1 US MARINE CORPS HQS HIST REF LIB ATTN MRS JADOT
1 CHF OF NAV OPNS OP-01P1
1 CHF OF NAVL OPS OP 037 WASH DC
1 CHF OF NAV OPNS OP-07TL
2 COMDT HQS 8TH NAV DIST ATTN EDUC ADV NEW ORLEANS
1 CHF OF NAV AIR TECH TNG NAV AIR STA MEMPHIS
1 DIR OPS EVAL GRP OFF OF CHF OF NAV OPS OP03EG
2 COMDT PTP COAST GUARD HQ
1 CHF OFCR PERS RES + REVIEW BR COAST GUARD HQ
1 CO US COAST GUARD TNG CTR GOVERNORS ISLAND NY
1 CO US COAST GUARD TNG CTR CAPE MAY NJ
1 CO US COAST GUARD TNG CTR & SUP CTR ALAMEDA CALIF
1 CO US COAST GUARD INST OKLA CITY OKLA
1 CO US COAST GUARD RES TNG CTR YORKTOWN VA
1 SUPT US COAST GUARD ACAD NEW LONDON CONN
1 OPNS ANLS OFC HQ STRATEGIC AIR COMD OFFUTT AFB
1 CINC STRATEGIC AIR COMD OFFUTT AFB ATTN SUP-3
1 AIR TNG COMD/XPT RANDOLPH AFB
1 TECH DIR TECH TNG DIV(HRD) AFHRL LOWRY AFB COLO
1 CHF SCI DIV DRCTE SCI + TECH DCS R+D HQ AIR FORCE AFRSTA
1 CHF OF PERS RES BR DRCTE OF CIVILIAN PERS DCS-PERS HQ AIR FORCE
1 CHF ANAL DIV (AFPDPL (R) DIR OF PERSONNEL PLANNING HQS USAF
2 DPTY TIG USAF (AFIAS-G1) NORTON AFB
2 CDR ELEC SYS DIV LG HANSCOM FLD ATTN ESMDA/STOP 36 MASS
2 SMAMA (SMACU-PERS RSCH) MCCLELLAN AFB
1 AFHRL/TT ATTN CAPT W S SELLMAN LOWRY AFB
1 HQ SAMSO (SMSIR) AF UNIT POST OFC LA AFS CALIF
2 MILIT TNG CTR OPE LACKLAND AFB
2 AFHRL (HRT) WRIGHT-PATTERSON AFB
1 AMD AMRH BROOKS AFB TEXAS
1 HQS ATC DCS/TECH TNG (ATTMS) RANDOLPH AFB
1 CDR ELEC SYS DIV LG HANSCOM FLD ATTN ESTI MASS
1 DIR AIR U LIB MAXWELL AFB ATTN AUL3T-63-253
1 USAF SCH OF AEROSPACE MED ATTN AEROMED LIB BROOKS AFB
1 USAFA DIR OF THE LIB USAF ACAD COLO
1 DRCTE OF AEROSPACE SAFETY AFIAS-L DPTY IG NORTON AFB
1 6570TH PERS RES LAB PRA-4 AEROSPACE MED DIV LACKLAND AFB
1 TECH TNG CTR (LMTC/OP-I-L1) LOWRY AFB
2 CO HUMAN RESOURCES LAB BROOKS AFB
1 COMDT USAF SPEC OP SCH (TAC) EGLIN AFB
1 AFHRL (FT) WILLIAMS AFB ARIZ
1 PSYCHOBIOLOGY PROG NATL SCI FOUND
1 DIR NATL SECUR AGY FT GEO G MEADE ATTN TDL
1 DIR NATL SECUR AGY FT GEO G MEADE ATTN DIR OF TNG

3 CIA ATTN CRS/ADD STANDARD DIST
1 SYS EVAL DIV RES DIRECTORATE DOD-DCD PENTAGON
1 DEPT OF STATE BUR OF INTEL + RES EXTERNAL RES STAFF
1 SCI INFO EXCH WASHINGTON
2 CHF MGT & GEN TNG DIV TR 200 FAA WASH DC
1 BUR OF RES & ENGR US POST OFC DEPT ATTN CHF HUMAN FACTORS BR
1 EDUC MEDIA BR OE HEW ATTN T D CLEMENS
1 NAT'L BUR STANDS BEHAV SCI GP ATTN DR D E ERLICK
1 OFC OF INTERNATL TNG PLANNING & EVAL BR AID WASH DC
1 FAA MED LIB HQ 640 WASH DC
1 DEPT OF TRANS FAA ACQ SEC HQ 610A WASH DC
2 ERIC OE WASH DC
1 CONSOL FED LAW ENFORCEMENT TNG CTR WASH DC
1 SYS DEVEL CORP SANTA MONICA ATTN LIB
2 DUNLAP + ASSOC INC DARIEN ATTN LIB
2 RAC ATTN LIB MCLEAN VA
1 RAND CORP WASHINGTON ATTN LIB
2 ELECT PERS RSCH GP U OF SOUTHERN CALIF
1 COLUMBIA U ELEC RES LABS ATTN TECH EDITOR
1 MITRE CORP BEDFORD MASS ATTN LIB
2 SIMULATION ENGR CORP ATTN DIR OF ENGR FAIRFAX VA
2 LEARNING R&D CTR U OF PITTS ATTN DIR
1 HUMAN SCI RES INC MCLEAN VA
2 TECH INFO CTR ENGNR DATA SERV N AMER AVN INC COLUMBUS O
1 CHRYSLER CORP MSL DIV DETROIT ATTN TECH INFO CTR
1 AVCO CORP AVCO MSL SYS DIV ATTN RSCH LIB WILMINGTON MASS
1 CTR FOR RSCH IN SOCIAL SYS ATTN LIBN MD
1 RAYTHEON SERV CO ATTN LIBN BURLINGTON MASS
1 GEN DYNAMICS POMONA DIV ATTN LIB DIV CALIF
2 OTIS ELEVATOR CO DIV ATTN LIB STAMFORD CONN
1 MGR BIOTECHNOLOGY AEROSPACE SYS DIV MS 8H-25 BOEING CO SEATTLE
1 IDA RSCH & ENG SUPT DIV ARL VA
1 SCI & TECH DIV IDA ARL VA
1 HUGHES AIRCRAFT COMPANY CULVER CITY CALIF
1 DIR CTR FOR RES ON LEARNING + TEACHING U OF MICH
1 EDITOR TNG RES ABSTR AMER SOC OF TNG DIRS U OF TENN
1 DIR CTR FOR RSCH IN SOCIAL SYS KENSINGTON MD
3 CANADIAN JOINT STAFF OFC OF DEF RES MEMBER WASHINGTON
3 CANADIAN ARMY STAFF WASHINGTON ATTN GSO2 TNG
2 CANADIAN LIAISON OFCR ARMY ARMOR BD FT KNOX
2 ROYAL SWEDISH EMBSY ATTN ARMY ATTACHE
3 AUSTRALIAN NAV ATTACHE EMBSY OF AUSTRALIA WASH DC
1 OFC OF AIR ATTACHE AUSTRALIAN EMBSY ATTN: T.A. NAVGN WASH, D.C.
2 DR B T DODD U OF SHEFFIELD DEPT OF PSYCHOL ENG
1 MENNINGER FOUNDATION TOPEKA
1 AMER INSTS FOR RSCH SILVER SPRING
1 AMER INSTS FOR RSCH ATTN LIBN PA
1 DIR PRIMATE LAB UNIV OF WIS MADISON
3 MATRIX RSCH CO FALLS CHURCH VA
1 EDUC & TNG CONSLT CO LA CALIF
1 OBERLIN COLL DEPT OF PSYCHOL
1 DR GEORGE T HAUTY CHMN DEPT OF PSYCHOL U OF DEL
1 VITRO LABS SILVER SPRING MD ATTN LIBN
1 HEAD DEPT OF PSYCHOL UNIV OF SC COLUMBIA
1 TVA PERS STAFF OFCR KNOXVILLE TENN
1 U OF GEORGIA DEPT OF PSYCHOL
1 U OF UTAH DEPT OF PSYCHOL
1 GE CO WASH D C
1 AMER INST FOR RSCH ATTN LIB PALO ALTO CALIF
1 COLL OF ARTS & SCI U OF MIAMI ATTN L L MCQUITTY
1 ROWLAND + CO HADDONFIELD NJ ATTN PRES
1 NORTRONICS DIV OF NORTHROP CORP ANAHEIM CALIF
1 OHIO STATE U SCH OF AVN
1 SCI RSCH ASSOC INC DIR OF EVAL CHICAGO ILL
1 AIRCRAFT ARMAMENTS INC COCKEYSVILLE MD
1 DR J B CULLEN DEPT OF SOC & ANTHROP UNIV OF RI
2 OREGON STATE U DEPT OF MILIT SCI ATTN ADJ

1 AMER PSYCHOL ASSOC WASHINGTON ATTN PSYCHOL ABSTR
1 NO ILL U HEAD DEPT OF PSYCHOL
1 GEORGIA INST OF TECH DIR SCH OF PSYCHOL
1 ENGNR LIB FAIRCHILD HILLER REPUBLIC AVN DIV FARMINGDALE N Y
1 LIFE SCI INC FT WORTH ATTN PRES
1 AMER BEHAV SCI CALIF
2 DIR INSTR RESOURCES STATE COLL ST CLOUD MINN
1 COLL OF WM + MARY SCH OF EDUC
1 SO ILLINOIS U DEPT OF PSYCHOL
2 ASSOC DIR CDC TNG PROG ATLANTA GA
2 WASH MILITARY SYS TECH LIB DIV BETHESDA MD
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1 U OF MINN DEPT OF INDUST EDUC ATTN R E KUHL
1 VOC-TECH EDUC PROG PLNNG DEV ATTN W STOCK ST PAUL
1 CHF PROCESSING DIV DUKE U LIB
1 U OF CALIF GEN LIB DOCU DEPT
1 FLORIDA STATE U LIB GIFTS + EXCH
1 PSYCHOL LIB HARVARD UNIV CAMBRIDGE
1 U OF ILL LIB SER DEPT
2 U OF KANSAS LIB PERIODICAL DEPT
1 U OF NEBRASKA LIBS ACQ DEPT
1 OHIO STATE U LIBS GIFT + EXCH DIV
1 PENNA STATE U PATTEE LIB DOCU DESK
1 PURDUE U LIBS PERIODICALS CHECKING FILES
1 STANFORD U LIBS DOCU LIB
1 LIBN U OF TEXAS
1 SYRACUSE U LIB SER DIV
1 SERIALS REC UNIV OF MINN MINNEAPOLIS
1 STATE U OF IOWA LIBS SER ACQ
1 NO CAROLINA STATE COLL DH HILL LIB
2 BOSTON U LIBS ACQ DIV
1 U OF MICH LIBS SER DIV
1 BROWN U LIB
1 COLUMBIA U LIBS DOCU ACQ
1 DIR JOINT U LIBS NASHVILLE
1 U OF DENVER MARY REED LIB
2 LIB GEO WASH UNIV ATTN SPEC COLL DEPT WASH DC
2 LIB OF CONGRESS CHF OF EXCH + GIFT DIV
1 U OF PGH DOCU LIBN
1 CATHOLIC U LIB EDUC & PSYCHOL LIB WASH DC
1 U OF KY MARGARET I KING LIB
1 SO ILL U ATTN LIBN SER DEPT
1 KANSAS STATE U FARRELL LIB
1 BRIGHAM YOUNG U LIB SER SECT
1 U OF LOUISVILLE LIB BELKNAP CAMPUS
1 GEORGETOWN U LIB SER DEPT WASH DC
1 LIBS COLO STATE U ATTN DOC LIBN FT COLLINS

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